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UNIVERSITY OF ALBERTA

***Comprehension monitoring in adults
with traumatic brain injury***

by



HEATHER RUTH HANCOCK

A thesis submitted to the Faculty of Graduate Studies and Research in
partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE
in SPEECH LANGUAGE PATHOLOGY

DEPARTMENT OF SPEECH PATHOLOGY AND AUDIOLOGY
EDMONTON, Alberta

Spring 1993



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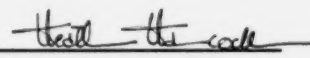
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entitled

***Comprehension monitoring in adults
with traumatic brain injury***

submitted by HEATHER RUTH HANCOCK in partial fulfillment of the
requirements for the degree of MASTER OF SCIENCE in SPEECH
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Abstract

The purpose of this study was to investigate spoken-language comprehension monitoring in adults with traumatic brain injury. A group of 18 adults with TBI and 18 neurologically normal adults were matched according to race, age, gender, and years of formal education. Comprehension monitoring was evaluated on the basis of participants' responses to a series of discussion questions which were designed to be either easy to understand and answer (control questions) or difficult to understand and answer (experimental questions). The experimental questions were difficult to understand because of contradictions, ungrammatical constructions, ellipsis or acronyms. Comprehension monitoring was evaluated by response time, frequency and form of comprehension monitoring responses. The results revealed that the TBI group signalled comprehension difficulties less often than the comparison group and used fewer interpretative responses than the comparison group. Descriptive analysis suggests that the two groups detected the same types of inadequate questions and responded with the same range of comprehension monitoring responses. Therefore, while their basic comprehension monitoring skills appear to be intact, the participants with TBI did not use them as frequently as the comparison subjects. The linguistic and social implications of these findings for adults with TBI are discussed.

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There has been an evolution in my attitude toward this project, starting with "it is humanly impossible to complete this project," changing to "I can't believe I'm getting somewhere with this project," and finally to, "it's done!" I think that this project would have been "humanly impossible" without the help of many people. I wish to remember a few key contributors.

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Chapter 1 • Introduction

Traumatic brain injury disrupts a wide range of cognitive functions and linguistic processes, commonly altering an individual's ability to communicate. Effective communication depends on higher level cognitive functions, such as anticipation, goal selection, planning, self-monitoring and use of feedback (Mattson & Levin, 1990). These cognitive functions are components of the "executive system" which Stuss and Benson (1986) propose works in a regulatory capacity with the basic mental processes (e.g., language, cognition, attention) to adjust ongoing cognitive activity. One function of the executive system, self-monitoring, is important for the detection of discrepancies between the present state and an internal mental comparison (Carver & Scheier, 1982). An important application of this process is self-monitoring of comprehension, wherein the listener monitors and evaluates his own comprehension of a spoken message in order to detect comprehension difficulties. Self-monitoring of comprehension, or "comprehension monitoring," is important to successful communicative interactions (Chapey, 1986b). Since impairment of the higher level cognitive functions following traumatic brain injury (TBI) is reportedly common (Mattson & Levin, 1990), deficits in self-monitoring of comprehension may also be present. Published reports of research on the effects of traumatic brain injury on comprehension monitoring skills are, however, few.

Ylvisaker and Szekeres (1989) note that "many patients fail to request clarification because of a failure to monitor their own comprehension of language" (p. 37). Similarly, Adamovich (1990) claims that subtle cognitive deficits following TBI may include "an inability to question or clarify in an attempt to gain additional information necessary to form an appropriate conclusion" (p. 15). However, these clinical observations need to be

empirically substantiated. The purpose of this study therefore was to investigate how adults who have suffered TBI signal comprehension difficulties.

A review of the literature will provide an overview of the neuropathology associated with TBI. Because the nature of the neuropathology generally determines the kind of resultant cognitive and linguistic impairments, this is an important aspect of brain injury to consider. Also reviewed here are the cognitive impairments following TBI which may disrupt those mental processes that support language functions. The types of language impairment secondary to cognitive impairment will then be presented. Finally, because impairments in both cognitive and linguistic functions following TBI may result in impairment in spoken-language comprehension monitoring, this metacognitive skill will be reviewed and approaches to studying it will be presented.

Chapter 2 • Literature Review

Traumatic Brain Injury

Neuropathology

TBI is "injury to the brain caused by primary physical trauma" (Brooke, Uomoto, McLean & Fraser, 1991, p. 17). Patients surviving moderate to severe head trauma are typically left with extensive cognitive and linguistic impairments which have a profound effect on long term recovery of function. A consideration of the primary and secondary pathophysiology and the diversity, severity, and potential patterns of neurological damage following TBI is important to understand the resultant cognitive-linguistic impairments.

Primary macroscopic or focal damage includes cortical contusions and lacerations (Levin, Benton & Grossman, 1982). "Coup" contusions are areas of damage directly underlying the point of trauma, caused by inbending of the skull or depressed bone fragments following skull fracture (Gurdjian & Gurdjian, 1976). Depressed skull fracture can also cause lacerations of the brain (Levin et al., 1982). "Contrecoup" contusions are those areas of damage linearly opposite the point of trauma, primarily a result of contact between the brain surfaces and the rough, irregular surface of the inferior cranium (Gurdjian & Gurdjian, 1976).

Primary microscopic or diffuse damage results from the rotational and horizontal forces generated by the primary trauma. These forces cause tearing and shearing of nerve fibres, producing widespread damage within the white matter, known as "diffuse axonal injury" (DAI) (Strich, 1956). When it occurs within the brainstem, DAI is responsible for the sudden loss of consciousness in moderate and severe head injuries (Ommaya & Gennarelli, 1974). Researchers consider this form of diffuse brain damage to be the critical factor in determining neurological outcomes, since it is the mechanism which produces

extensive, widespread brain damage (Strich, 1956; Adams, Mitchell, Graham & Doyle, 1977).

Secondary brain damage can be produced by cerebral and systemic complications. Elevated intracranial pressure is one such cerebral complication which can cause compression of tissue, nerves and vessels, producing secondary brain damage (Miller et al., 1977). Owing to the circular causal relationship between brain damage and elevated intracranial pressure, Miller et al. (1977) conclude that "raised ICP [intracranial pressure] constitutes an important factor in the clinical course of the patient with severe head injury" (p. 512). Systemic complications such as low blood pressure (hypotension), arterial oxygen levels below normal (hypoxia), or abnormally high levels of arterial carbon dioxide (hypercarbia) can also produce secondary brain damage, increasing the severity of the head injury (Miller, Sweet, Narayan & Becker, 1978).

There is much diversity in the type of brain damage caused by the primary and secondary trauma. A consideration of the diversity of brain damage following TBI is important because diverse types of brain damage lead to diverse types of cognitive and linguistic impairment. The type of brain damage present following TBI depends largely on the nature of the primary trauma. No two injuries are identical: variations in the force and direction of the primary trauma produce differing amounts of focal and diffuse damage in cortical and subcortical regions (Alexander, 1982). While the effects of isolated focal damage may be predictable, TBI typically involves more than one form of damage. Both focal and diffuse types of brain damage can co-occur to produce mixed brain damage. Alexander (1987) notes that the "additive consequences of two different processes are impossible to predict" (p. 197). Given that the nature of the primary trauma is unique to each TBI patient, the locus and type of brain damage following head injury is extremely varied among patients. The interaction of diverse primary and secondary neurological trauma with other factors such as premorbid cognitive, behavioral, linguistic and social

characteristics, co-morbidities, and post-injury environment and rehabilitation accounts for the reported heterogeneity of TBI populations (Hartley & Levin, 1990).

A second factor to consider in addition to diversity of brain damage, is the potential severity of brain damage. It is important to understand that the severity of brain damage influences the severity of the resultant cognitive-linguistic impairments. Stuss and Benson (1986) propose that the initial trauma generates a "pressure wave" that has the potential to affect the entire brain. Ommaya and Gennarelli (1974) claim that the severity of brain damage is directly related to the magnitude of the force to the head during the initial trauma. Their approach is summarized by Levin et al. (1988): "the magnitude of acceleration/deceleration imparted to the head determines shear strain and extent of DAI, depth of brain lesion, and the degree and persistence of impaired consciousness" (p. 865).

The significance of knowing the severity of the brain damage is that the greater the brain damage, the poorer the long-term outcomes (Wilson, Vizor & Bryant, 1991). Several predictors of severity have been proposed: age and premorbid IQ (Wilson et al., 1991), duration of coma (Teasdale & Jennett, 1974), duration of post-traumatic amnesia (Russel & Smith, 1961), abnormal electroencephalographic records, cerebral contusion, edema, and concussion (Smith, 1961). Jennett et al. (1977) claim that "the most widely accepted indicator of brain damage is the extent and duration of impairment of conscious level" (p. 292). Wilson et al. (1991) found significant correlations between post-trauma cognitive status and length of coma, confirming "an established relationship wherein the longer the coma, the worse the brain damage and the greater the cognitive impairments" (p. 195). Two measures of the extent of impaired consciousness have been proposed: duration of post-traumatic amnesia (Russel & Smith, 1961) and duration of coma (Teasdale & Jennett, 1974).

Smith (1961) defined post-traumatic amnesia (PTA) as "the length of the interval during which a patient with a non-focal closed head injury is unable to record his

experience" (p. 73). Smith reviewed research studies which employed various predictors of severity and concluded that "PTA appears to be the most reliable single index of severity" (p. 73). Russel and Smith (1961) provided a classification of the severity of brain damage based on the length of PTA: PTA of less than one hour is associated with slight injury; PTA of one to twenty-four hours is associated with moderate injury; and PTA of one to seven days is associated with severe injury. However, because there are few systematic, standardized procedures for defining and establishing length of post-traumatic amnesia (Fortuny, Briggs, Newcombe, Ratcliff & Thomas, 1980), the reliability of PTA duration as a measurement of severity of brain damage remains questionable.

Due to the variability in measuring PTA duration, other researchers have proposed that the length of coma is a valuable indicator of extent of damage. Teasdale and Jennett (1974) developed the Glasgow Coma Scale to provide a more objective tool for measuring duration of coma. According to this scale, "coma was defined as the inability to obey commands, to utter recognizable words, or to open the eyes; if any of these could be achieved the patient was regarded as not in coma" (Jennett et al., 1977, p. 292). Eye opening, motor responses, and verbal responses are assessed, and a total score calculated to estimate severity of injury: a score of 9 to 12 is associated with moderate head injury, and a score of 8 or less is associated with severe head injury (Kolb & Wishaw, 1990). Teasdale, Knill-Jones and van der Sande (1978) investigated the reliability of the Glasgow Coma Scale for measuring coma duration. Observer variability in assessing impaired consciousness was found to be reduced by the provision of operational definitions for terminology, the use of standardized procedures for patient examination, and experience with using the scale. The authors concluded that provided care is taken in the elicitation and interpretation of responses, the Glasgow Coma Scale provides a practical, reliable scale for assessing coma duration.

Severe brain damage and diversity in the nature of the damage following TBI render the survivors of such trauma a population with widespread impairment in many different functions. However, despite this characterization of brain damage following TBI, researchers report that consistent patterns of damage can also be identified. Alexander (1982) claims that the primary mechanisms of TBI produce relatively consistent patterns of brain injury. There is a propensity for focal lesions to occur in the frontopolar, orbitofrontal and anterior temporal regions (Gurdjian & Gurdjian, 1976; Ommaya & Gennarelli, 1974). These regions are susceptible to damage because of their proximity to the bony prominences of the inferior cranium: the orbital plates, middle fossae and inferior sphenoid wings (Gurdjian & Gurdjian, 1976). Ommaya and Gennarelli (1974) note "it would follow that those parts of the cortex covered by smooth surfaces (e.g., occipital lobes) should suffer the least damage whereas those portions covered by rough surfaces (e.g., the temporal lobes, frontal poles and orbital cortex) would suffer the most" (p. 637). Similarly, diffuse damage, DAI, has been found to occur in predictable sites. Adams et al. (1977) state that the hallmarks of brain damage caused by DAI are "focal lesions in the corpus callosum and in the dorsolateral quadrant of the brainstem, and microscopical evidence of widespread damage to the white matter" (p. 500). Based on these reports of patterns of damage following TBI, researchers have sought to identify patterns in the resultant cognitive-linguistic impairments. Identifying patterns of impairment is useful for describing the TBI population; however, care must be taken in interpreting these findings because this population is so heterogeneous. Identifying differences within the population is an equally important component of the effort to develop an accurate and complete description of the impairments associated with TBI.

In summary, brain damage following TBI can be diverse and potentially severe. Researchers have also identified patterns in brain damage following TBI. Diversity of damage is inevitable considering the variations in primary trauma which produce

idiosyncratic focal and diffuse, primary and secondary damage. This diversity contributes to the heterogeneity of the TBI population. The potential for severe damage to the brain is contingent upon the magnitude of the original trauma. An index of the severity of the brain damage helps predict the severity of impairment of cognitive and linguistic function. Finally, patterns of damage involving the anterior temporal, orbitofrontal and frontopolar regions of the brain are commonly present. These records of damage distribution suggest that patterns may also be present in the consequent cognitive and linguistic impairments.

Neuropsychological Impairments

The primary and secondary neuropathology in TBI commonly effect significant impairments in neuropsychological processes. Impairments in neuropsychological function, in turn, can directly influence communicative ability. Researchers have found relationships between both severity and patterns of neuropathology and patients' neuropsychological profiles. Wilson et al. (1991) report that neuropsychological impairments vary directly with the severity of brain damage since the greater the brain damage, the greater the cognitive impairment. Researchers have also found that certain patterns of brain damage can be associated with certain patterns of neuropsychological impairment.

There are two distinct approaches to studying neuropsychological function following TBI. First, the neuroanatomical approach is based on the premise that specific mental functions and processes are associated with specific regions of the brain (Nauta, 1971). According to this approach, by considering the type and location of brain damage, certain patterns of cognitive impairment can be expected. Second, the neuropsychological approach to studying cognitive function dissociates cognitive processes from neuroanatomy. Evaluation of the component cognitive processes following TBI is made apart from neuropathology.

Following a neuroanatomical approach, Kolb and Wishaw (1990) report that the type of cognitive impairment found in TBI patients is closely related to the type of brain damage produced by the injury. Diffuse brain damage often produces general cognitive impairment characterized by "a general loss of complex cognitive functions, including reductions in mental speech, ability to concentrate, and overall cognitive efficiency" (p. 138). Focal brain damage, on the other hand, generally leads to deficits in specific cognitive functions. Given that the frontal and temporal lobes are susceptible to focal brain damage (Gurdjian & Gurdjian, 1976), impairments in the cognitive and behavioral functions mediated by these areas of the cortex are commonly found (Kolb & Wishaw, 1990).

Behaviors mediated by the frontal lobes include higher level mental processing, monitoring and control of internal and external environments (Mattson & Levin, 1990), and behavioral programming (Nauta, 1971). Therefore, damage to the frontal lobes is associated with impairments in these processes. Deficits in higher level cognitive processes can result in impaired reasoning and problem-solving skills, impaired judgement and insight; diminished motivation; increased impulsivity; deficient social interaction skills; and altered personality and behavior (Alexander, 1982). Stuss and Benson (1986) note that the monitoring and control functions of the executive system and metacognitive processes are commonly impaired following frontal lobe lesions. The function of the executive system is "to take the information extracted from other, higher brain systems, verbal and nonverbal, and to anticipate, select goals, experiment, modify and otherwise act on this information to produce novel responses" (Stuss & Benson, 1986, p. 246). Metacognition involves "the ability to reflect upon what the constituent elements and the processes of cognition themselves may mean for the organism" (Alexander, Benson & Stuss, 1989, p. 658). Impairments in this ability to reflect on one's own cognitive processes and to monitor and control cognitive activity reduce efficiency and efficacy of cognitive processing.

Disruptions in temporal lobe functions may produce impairments in auditory comprehension (Kolb & Wishaw, 1990) and memory (Alexander, 1982). Additionally, damage to the neocortical portions of the limbic system within the temporal lobe is common following TBI, producing disruptions in affective and emotional responses. Alexander (1982) claims that it may be more difficult for a TBI patient to overcome and compensate for these behavioral disorders than to adjust to long-term cognitive impairments.

The neuropsychological approach to an individual who has suffered TBI considers the integrity of the component mental processes independent of the site of lesion. Adamovich (1990) discusses the impairments in attentional, cognitive, and information processing skills which may disrupt linguistic processes. Impaired attentional skills interfere with an individual's "ability to appropriately deal with information in the environment" (p. 17). Deficiencies may range from inability to sustain attention through inability to attend selectively to the important features of incoming information. Cognitive skills commonly impaired following TBI include perception, discrimination, organization, memory, reasoning, and problem solving. Impairments in perception alter the process of "integration and interpretation of information received at the sense organs based on an internal or stored representation of the stimulus" (p. 12). Impairments in discrimination reduce the ability to distinguish two or more stimuli. Impairments in organizational processes limit the ability to classify stimuli in a systematic manner. Memory deficits occur "due to ineffective encoding of information, inadequate storage of information, difficulty retrieving information using recognition, cued recall or free recall and a lack of strategies to deal with interferences" (p. 13). Impairments in reasoning and problem solving disrupt an individual's ability to generate possible alternatives for solving problems and to evaluate the adequacy of these alternative solutions. Information processing may be affected after TBI because the patient's ability to recognize, sequence, compare, and analyze incoming

information may be altered. The ability to use internal and external feedback in generating and revising behavioral responses may also be impaired.

In summary, neuropsychological impairments following TBI have been identified and studied in two ways. First, the neuroanatomical approach to describing neuropsychological impairments predicts that damage to specific regions of the brain will produce deficits in certain mental processes. Frontal lobe lesions are associated with deficits in higher level cognitive functions, such as monitoring and evaluation of mental processing. Temporal lobe lesions are associated with memory impairments and deficits in auditory comprehension. Widespread diffuse damage to the white matter typically results in generalized loss of cognitive efficiency in processing. Second, the neuropsychological study of the sequelae of TBI has revealed that impairments in attentional abilities, cognitive processes, and information processing are common.

Language Impairments

Language and cognition are interrelated and interdependent processes (Adamovich, 1990). It is this "interdependent relationship between cognition and language that allows the individual to generate, assimilate, retain, retrieve, organize, monitor, respond to and learn from the environment" (Deruyter & Kennedy, 1991, p. 128). Because these two processes are interdependent, neuropsychological impairments following TBI can affect language processes, producing "cognitive-linguistic" impairments (Hagen, 1981). Impairments are apparent in both expressive and receptive modes of language.

Holland (1977) claimed that persons with aphasia communicate better than they talk. With patients who have suffered TBI, however, the reverse generally holds true: "[they] talk better than they communicate" (Milton, Prutting & Binder, 1984, p. 114). This characterization of language abilities following head injury is supported by an apparent dissociation of microlinguistic (e.g., phonology, morphology, semantics and syntax) and

macrolinguistic parameters (e.g., pragmatics). Phonologic, semantic, and syntactic linguistic ability is generally preserved in subjects with TBI. A few specific microlinguistic impairments are, however, commonly present in subjects with TBI. The most common and consistently present linguistic impairment is anomia (Heilman, Safran & Geschwind, 1971; Levin et al., 1976; Sarno, 1980). Levin et al. (1976) found that 60% of 50 subjects with TBI demonstrated significant word finding difficulties. Anomic errors include semantic and literal paraphasias (Hartley & Levin, 1990). It is, however, primarily at the suprasentential level that the expressive language impairments of subjects with TBI become apparent because higher-level or macrolinguistic skills which involve "maintaining conceptual and pragmatic organization at the suprasentential level" are often impaired (Glosser & Deser, 1990, p. 68). Verbal patterns typically exhibited by subjects with TBI have been described as confabulatory, tangential, irrelevant, fragmented and incoherent (Penn & Cleary, 1988). These characteristics are symptomatic of deficiencies in pragmatic functioning. Several recent studies investigating the language impairments in subjects with TBI have reported significant impairments in language use: impaired topic management skills (Mentis & Prutting, 1991), decreased ability to produce cohesive text (Mentis & Prutting, 1987), inappropriate verbal interaction skills (Giles, Fussey & Burgess, 1988), decreased efficiency in communication (Ehrlich, 1988), and impaired topic selection and maintenance, turn-taking initiation, and interpretation of prosodic and affective information (Milton et al., 1984).

Receptive language abilities and impairments are addressed less frequently in the literature. Impairments in the ability to follow complex commands has been reported, indicative of disordered auditory comprehension (Levin, Grossman & Kelly, 1976; Sarno et al., 1986; Hartley & Levin, 1990). Levin et al. (1976) found that 32% of 50 subjects with TBI demonstrated difficulties comprehending complex commands.

These disruptions in language processing are thought to be related to impairments in cognitive processes. Slowed cognitive processing, memory deficits, poor social perception, impaired executive function (Hartley & Levin, 1990), and global attentional disorders (Adamovich, 1990) have been proposed as possible mechanisms underlying these linguistic impairments. Adamovich (1990) claimed that "head injured persons generally fail to communicate due to generalized cognitive, information processing and attentional factors rather than purely linguistic factors" (p. 16). Similarly, Levin et al. (1976) attributed the linguistic impairments present in subjects with TBI to general mental impairment following head trauma.

These cognitive-linguistic deficits following TBI are reportedly different from aphasia. Adamovich (1990) claimed that aphasic "individuals evidence predominant linguistic disturbances" while head injured patients have "predominant cognitive disturbances which are responsible for the majority of resulting behaviors" (p. 17). Holland (1982) compared the language impairments associated with aphasic and TBI populations and claimed that they are fundamentally more different than similar. Similarities in the language impairments of persons with aphasia and those with TBI include word retrieval problems and disordered auditory comprehension. In terms of differences, Holland claimed that "it is in the area of language pragmatics that aphasia and head-injured language most vividly contrast" (p. 347). Aphasia can be classified as a disorder of language form while the language dysfunction caused by TBI is primarily a disorder of language use. Many researchers support this dichotomy between persons with aphasia and TBI (Holland, 1982; Braun & Baribeau, 1987; Hagen, 1981; Levin et al., 1976). However, Sarno (1980) investigated the verbal impairments of 56 closed head injury patients and reported that approximately 33% of the group exhibited classic signs of aphasia defined as "specific deficits in the processing of information via the speech code" (p. 690). The other 66% exhibited "subclinical aphasia," defined as "evidence of linguistic

processing deficits on testing in the absence of clinical manifestations of linguistic impairments" (p. 690). These findings were confirmed in a replication study (Sarno, 1984). Holland (1982) said that while Sarno's (1980) results indicate that some patients with TBI are aphasic, "aphasia is probably NOT aphasia in the vast majority of the head injured" (p. 346). She contended that the language problems following TBI are "more likely to be the manifestations of more general and more pervasive memory and cognitive deficits" (p. 346).

In summary, given the potential for extensive impairments in mental processes and the close relationship between cognition and language, language impairments following TBI might be expected. Deficits in expressive language are predominantly at the level of language use rather than language form. Receptive language is commonly impaired by disordered auditory comprehension. While some patients with TBI may exhibit signs of aphasia, the cognitive-linguistic impairments associated with TBI are considered quite different from the aphasic symptoms associated with left hemisphere cerebral vascular accidents.

As a result of TBI, the areas of the brain responsible for basic cognitive processes (e.g., attention, perception, or memory) may be damaged, potentially producing deficits in linguistic processes (e.g., auditory comprehension). Damage to areas of the brain responsible for mediation, monitoring, and regulation of these basic cognitive and linguistic processes could potentially result in deficits in important self-monitoring functions. As a result of these impairments, the process of comprehension monitoring could potentially be disrupted following TBI.

Comprehension Monitoring

Comprehension is the process of constructing a representation of meaning that is consistent with the speaker's original message. The success or failure of comprehension is regulated by comprehension monitoring. Comprehension monitoring is "a metacognitive skill that allows listeners to notice and respond when they encounter messages that are difficult to comprehend" (Dollaghan, 1987). Persons who have suffered head injuries may exhibit impairments in this skill because regions of the brain which control metacognitive functions and facilitate auditory comprehension of linguistic input are commonly damaged following TBI.

The importance of comprehension monitoring becomes evident when the inherent complexity of communicative interaction is considered. The unique perceptual systems, cognitive processes, linguistic knowledge, and communicative competencies of both conversational partners interact with the speaker's communicative intent and the listener's interpretation of that intent, making communication a complex endeavour (Chapey, 1986a). Therefore, while the conceptualization and encoding of propositional content by the speaker is an extremely complex process, the listener must possess an equally complex set of skills with which to receive, decode, process and evaluate the speaker's message.

Comprehension monitoring involves two components: detection and reaction. Detection depends on a complex interaction of auditory reception and processing, cognitive processing and metacognitive evaluation. An auditory signal is received and processed. Cognitive processing allows the formation of a conceptual representation of the original proposition. Metacognitive and executive functions work cooperatively with linguistic and cognitive processes to facilitate the listener's ability to self-monitor. Self-monitoring is necessary to detect message inadequacies and to reflect upon the status of the listener's own understanding in order to evaluate the representation of the message he has constructed

(Stuss & Benson, 1986). It is through this evaluative process that the listener decides whether or not a problem in comprehension exists.

The ease with which the listener can detect comprehension difficulties is affected by a number of message and listener variables. Message variables which can affect detection include the integrity of the acoustic signal, rate of presentation (Dollaghan & Kaston, 1986), the amount and distribution of information (Markman, 1981), topic familiarity and message clarity, complexity and abstractness (Dollaghan, 1987). Listener variables which can affect detection include the adequacy of the listener's linguistic and cognitive knowledge. The listener must possess adequate linguistic knowledge and cognitive skill in order to judge message adequacy. Message form is evaluated based on linguistic knowledge of phonologic, morphologic, semantic and syntactic parameters. Message content is evaluated based on linguistic knowledge of pragmatic conventions and on comparisons with internal, stored representations from past experience and prior knowledge (Adamovich, 1990).

The second component of comprehension monitoring is reaction to a comprehension breakdown. A listener may react in a number of ways: request immediate clarification for the inadequate message, wait for additional information to clarify the problem, or form a tentative interpretation of the message intent. The way in which the listener will react is influenced by listener and situation variables. The listener's motivation to succeed in the communicative interaction is related to the perceived importance of understanding the message and will affect how he reacts to message inadequacies (Dollaghan, 1987). Additionally, Goffman (1976) proposes that a barrier to constructive reactions to comprehension problems is the listener's reticence to acknowledge comprehension difficulties which may be the result of listener inattention or lack of knowledge. Situation variables which can affect the way a listener reacts following detection of message inadequacies include: the availability of contextual cues which could

supplement the message and clarify speaker intent; the opportunity to clarify the message later in the interaction; or the decision to review the communication from memory at a later time to resolve ambiguities.

An explicit reaction signalling communication breakdowns can be either verbal or nonverbal. Schegloff, Jefferson and Sacks (1977) present a series of verbal responses which serve to request clarification: nonspecific (e.g., "huh?" or "what?"), specific interrogative (e.g., wh-question words), partial repeat of the inadequate message plus an interrogative, partial repeat of the inadequate message, and proposal of possible interpretation (e.g., "do you mean ..."). These verbal comprehension monitoring responses vary in the extent to which they identify the trouble source within a message. Nonspecific responses (e.g., "huh?") provide the speaker with little information regarding what aspect of the message was inadequate. Conversely, more specific responses (e.g., "do you mean...?") serve to identify the trouble source within a message, helping the speaker to repair the communication breakdown more effectively and efficiently. Schegloff et al. (1977) claimed that repair types can be ordered hierarchically based on the explicitness with which the inadequate portion of a message is located by the repair initiator. Based on this assumption, McTear (1985) proposed a sequential ordering of clarification requests which range from weakest to strongest in terms of explicitness with which the trouble source is identified by the request: non-specific request for repetition, specific request for repetition, specific request for specification, potential request for elaboration, specific request for confirmation, and "you mean" plus specific request for confirmation.

Nonverbal responses have also been identified as important repair initiators: facial expressions conveying puzzlement (e.g., raised eyebrows); manual expressions (e.g., scratching head); or gestures indicating uncertainty (Flavell, Speer, Green & August, 1981).

It is important to differentiate these informative verbal and nonverbal repair initiations from "back channel behavior." Goffman (1976) defines back-channel responses as "keep going" signals for the speaker that do not convey informative feedback to the speaker. Back-channel responses can be verbal, including short verbalizations (e.g., "mmm" or "OK") and longer verbalizations (e.g., sentence completions), or nonverbal (e.g., head nods or smiles) (Duncan & Fiske, 1977). Bublitz (1988) proposes the term "hearer signals" for such uninformative messages which confirm that communication is taking place but do not necessarily indicate listener attention, agreement or even comprehension.

Comprehension monitoring has been investigated primarily in children. Dollaghan (1987) found that studies of comprehension monitoring rely on listeners' verbal reactions to a comprehension problem rather than the detection of it "for the excellent reason that detection is a covert event, not necessarily reflected in observable behaviors" (p. 50). Studies therefore rely on listeners' overt verbal reactions as evidence of their comprehension monitoring skills. Markman (1977) investigated children's awareness of their own comprehension failure as measured by their verbal reactions to incomprehensible instructions. Markman conducted one experiment with thirty-six normally developing children in grades one to three and a second experiment with 40 children in grades one or three. Both experiments employed referential communication tasks wherein the children learned a magic trick or a card game by following instructions from the examiner. Some of these instructions were designed to be incomprehensible in order to elicit a comprehension monitoring response. The older children quickly detected comprehension difficulties while the younger children often failed to note blatant message inadequacies until they attempted to physically perform the task. The author proposed that this is due to an absence of constructive processing: superficial processing allows the child to be unaware of the insufficiencies of the message.

Flavell, Speer, Green and August (1981) conducted an indepth investigation of the development of comprehension monitoring and knowledge about communication in kindergarten and second grade children. Sixty-four children completed a block building task, following audio-taped instructions which were either adequate, problematic-inadequate or problematic-adequate. The older children detected and reacted to problematic instructions more consistently than did the younger children. A second study with 20 children demonstrated that the younger children's inability to consistently monitor their comprehension is not simply a result of memory limitations.

Donahue, Pearl and Bryan (1980) studied how children with learning disabilities responded to inadequate messages. Sixty-one learning disabled children and 55 matched controls participated in this investigation of conversational rules for repair of communication breakdowns. A referential communication task was used to evaluate comprehension monitoring wherein the listener was required to select referents based on messages of varying informational adequacy. Responses were scored in terms of number of requests for more information, the accuracy of performance, and latency of response. Learning disabled children made fewer requests for clarification of inadequate messages. The authors propose that this is not necessarily a syntactic-semantic impairment but may be a result of deficiencies in social knowledge. That is, learning disabled children may lack knowledge of conversational rules which obligate the listener to identify and initiate repair of communication breakdowns. Meline and Brackin (1987) studied language-impaired children's ability to evaluate message adequacy. Fifteen language-impaired, 15 age-matched, and 15 younger control children listened to two stories in which speakers' inadequate messages caused communication breakdowns. Language-impaired and younger control subjects attributed communication failures to the listener rather than the speaker, indicating an impaired or immature ability to evaluate the adequacy of message content. Hargrove, Straka and Meddars (1988) studied the form of comprehension monitoring

responses in 13 children with language impairments, 13 age-mates and 13 younger children. The authors investigated the use of verbal and nonverbal behaviors to signal communication failures. Messages with varying levels of lexical and syntactic complexity were presented and the children were requested to act out the experimental sentences using toys. Both groups of children were able to provide feedback regarding communication breakdowns; however, children with language impairments tended to use non-specific clarification requests and more covert indications of comprehension difficulties.

Dollaghan and Kaston (1986) reported the results of a multiple baseline treatment study designed to improve comprehension monitoring skills of four children with language impairments. Message variables (acoustic signal, message content, and complexity) were systematically varied to facilitate awareness of noncomprehension and to elicit comprehension monitoring responses. The authors claimed that comprehension monitoring is an important “‘survival skill’ that could facilitate many of [the children’s] interpersonal and academic interactions” (p. 264). A marked increase in the frequency of requests for clarification following a five-week treatment period led the authors to conclude that “intervention aimed at facilitating [language-impaired] children’s comprehension monitoring skills appears to be both feasible and effective and seems likely to be an extremely useful adjunct to treatment focusing on remediation of their underlying linguistic deficits” (p. 269).

Studies of comprehension monitoring in adult populations are few. Logan (1990) investigated comprehension monitoring skills in elderly adults (70 to 80 years) as compared to young adults (18 to 25 years). Logan employed a direction following task whereby subjects completed “errands” on a game board according to audio-taped instructions. These instructions were designed to be either adequate or inadequate. Comprehension monitoring skills were evaluated in terms of frequency of comprehension monitoring responses to inadequate instructions, the form of these comprehension monitoring

responses, and the latency of these responses following presentation of the instructions. Results revealed that comprehension monitoring skills were relatively intact in the elderly adults in Logan's study. Differences were found between the two groups in terms of the form and latency of comprehension monitoring responses. Elderly adults used more verbal than nonverbal comprehension monitoring responses as compared to the young adults. Elderly adults also responded more slowly to inadequate stimuli than the younger adults.

Although investigations of comprehension monitoring in children have employed referential communication games and activities, it would be advantageous to employ methods which are more socially valid to evaluate comprehension monitoring in adult populations. Using a socially valid method for evaluating comprehension monitoring enhances the probability that the listener's use of this linguistic skill in the experimental setting is representative of his use of this skill in daily communicative interactions. In this way, a more accurate measure of comprehension monitoring skill may be obtained. Printz (1980) investigated how persons with aphasia were able to formulate requests using a naturalistic setting since "formal diagnostic and treatment sessions seem to minimize the aphasic's opportunity to reveal these underlying intentions" (p. 65). Ten "requesting elicitors" were presented during a 20 minute conversation. These requesting elicitors were "conversational situations constructed to elicit requests" (p. 67), such as providing the subject with a broken pencil and asking him to write his name or showing the subject pictures of unfamiliar people. The author found that although the form and specificity of the requests varied greatly between subjects, all the aphasic subjects were able to formulate requests. This study provides an example of how socially valid methods of eliciting the target behavior may provide a more accurate estimate of linguistic skill. For adults with TBI, using a socially valid, naturalistic method for evaluating comprehension monitoring is especially important because an experimental setting that is highly structured and contrived can result in a distorted measure of metacognitive function. Ylvisaker and Szekeres (1989)

note that "formal testing by its very nature compensates for many of the more debilitating executive impairments" (p. 38). Therefore, an informal, naturalistic communicative setting should be employed for evaluating comprehension monitoring in adults with TBI.

Simulation of natural settings, however, introduces a number of methodological problems. Developing procedures that are naturalistic and yet can effectively and consistently elicit the target behavior is difficult. Similarly, standardizing procedures that are intended to be naturalistic is problematic. Operational definitions and objective methods of measurement must be developed in order to describe target behaviors (McReynolds & Kearns, 1983).

Finally, the functional significance of effective comprehension monitoring skills for adults who have sustained TBI needs to be considered. Comprehension monitoring skills are essential to effective communication. Effective communication is fundamental to developing and maintaining personal and professional relationships; therefore, limitations in communicative ability can adversely affect relationship formation or maintenance. Successful relationships between rehabilitation professionals and patients with TBI are important. Because the rehabilitation process employs an interdisciplinary team approach in which the patient is regarded as an important team member (Mackey, 1980), that patient's understanding of and input to the development of rehabilitation goals increases his/her motivation and cooperation, thereby affecting rehabilitation outcomes.

Effective communication is also important for the traumatically brain injured person's successful reintegration into society. Executive functions, such as comprehension monitoring, are integral to the recovery of maximal independence. Ylvisaker and Szekeres (1989) claim that deficits in executive functions are critical "because of the powerful direct effects they have on productive independent living" (p. 36). Similarly, Pollens, McBratnie and Burton (1988) state that "to ignore the executive function component in the closed head injured patient is to ignore the very factors which may impede successful return to home

and community life" (p. 27). Brooks, McKinlay, Symington, Beattie and Campsie (1987) investigated the factors that affect TBI patients' reintegration into the workplace. In a group of 98 patients with severe head injury, the authors found a drop in employment rate from 86% pre-injury to 29% post-injury. They report that communicative ability, in particular, the ability to understand and carry on conversation, is a significant predictor of eventual return to work following TBI. These conversational abilities involve the active participation of the listener in monitoring his own comprehension, a cooperative effort important to the maintenance of communication (Chapey, 1986b).

In summary, comprehension monitoring is an important process by which a listener detects message inadequacies and reacts to them. The active participation of the listener in communicative interactions in receiving, processing and evaluating incoming messages is important given the complexity of communication. Message, listener and situation variables may influence the detection of and reaction to message inadequacies. The majority of studies of comprehension monitoring have been with children using referential communication games and contrived activities. For adults with TBI, socially valid and naturalistic methods of investigating comprehension monitoring may result in more accurate estimations of comprehension monitoring skills in daily language use than formal, structured diagnostic testing methods can reveal. Finally, comprehension monitoring is a functionally significant skill, potentially affecting rehabilitation outcomes and reintegration into society.

Conclusion

The executive system is susceptible to damage following TBI. Disruption in the executive functions of self-monitoring may impair comprehension monitoring of spoken language. Impaired comprehension monitoring decreases the efficiency with which communication breakdowns are detected and resolved, and ultimately limits the success of communicative interactions. Limitations in communication may adversely affect rehabilitation outcomes and reintegration into society.

It is important to determine if comprehension monitoring abilities are impaired in patients who have suffered TBI so that steps can be taken to offset the effect of such impairments on communication. First, speech-language pathologists can focus on training executive function skills as a part of the rehabilitation process (Ylvisaker & Szekeres, 1989). Second, other people in the patient's environment can be alerted to the impairment and can take more responsibility for monitoring the patient's comprehension in communicative interactions. Lubinski, Duchan and Weitzner-Lin (1980) analyzed breakdowns in communication for an aphasic adult and concluded that the patient's conversational partners should be alerted to the impairment and assume more responsibility for the maintenance of smooth conversational flow. This strategy could also be used with patients who have sustained TBI.

Statement of Problem

A review of the literature indicates that severe head injury may produce significant cognitive and linguistic impairments. The propensity for closed head injury to damage the areas of the brain which control, regulate, and monitor other cognitive processes predicts that the metacognitive skill of comprehension monitoring may be impaired following TBI. Comprehension monitoring of spoken language is important to effective communicative interaction. Effective communication influences the success of personal and professional relationships, potentially affecting rehabilitation outcomes and eventual reintegration into society. Thus, knowledge of whether or not comprehension monitoring impairments exist in a person with brain injury would facilitate the implementation of appropriate remediation, yet there is a paucity of literature addressing this issue. To that end, an investigation of comprehension monitoring skills in adults with TBI was warranted and was undertaken.

Statement of Purpose

The purpose of this study was to answer the following research questions:

Do adults who have sustained TBI differ from matched neurologically normal comparison subjects in their ability to signal communication breakdowns according to the following criteria?

Mean response time to signal communication breakdown:

Do participants with TBI require more time to respond to experimental versus control questions?

Do comparison subjects require more time to respond to experimental versus control questions?

Do subjects with TBI differ from comparison subjects in the time required to respond to control or experimental questions?

Frequency of comprehension monitoring responses:

Do participants with TBI produce more comprehension monitoring responses to experimental versus control questions?

Do comparison subjects produce more comprehension monitoring responses to experimental versus control questions?

Do participants with TBI differ from comparison subjects in the frequency with which comprehension monitoring responses are produced in response to control or experimental questions?

Form of responses to signal communication breakdown:

Which type of verbal comprehension monitoring responses do subjects with TBI use most frequently?

Which type of verbal comprehension monitoring responses do comparison subjects use most frequently?

Do participants with TBI differ from comparison subjects in the type of verbal comprehension monitoring responses produced in response to experimental questions?

Chapter 3 • Methodology

Pilot Study

A pilot study was completed to evaluate the effectiveness of a discourse level, interactive task designed to measure comprehension monitoring in adults (Hancock, 1991). Six undergraduate students at the University of Alberta were recruited by means of personal contacts to participate in this study. The investigator initiated a discussion with each participant using a series of 32 discussion questions. Twenty of these questions were designed to be easy to understand and answer. The remaining 12 questions were designed to be difficult to understand and answer, creating the opportunity to elicit a comprehension monitoring response. Participants' response times for both the easy and difficult questions were taken as a measure of their awareness of comprehension difficulties. Participants' responses to the difficult questions were taken as an indication of their ability to signal comprehension breakdowns.

On average, participants took longer to respond to the difficult questions than to the easy questions. The participants signalled comprehension breakdowns more frequently for the difficult questions than the easy questions. The form of these responses ranged from nonspecific repetitions of the questions to proposals of possible interpretations of the meaning of the difficult questions.

Overall, the pilot study served to confirm that the experimental task chosen to assess comprehension monitoring was pragmatically appropriate. That is, participants actively engaged in the discussion with the investigator and were reportedly not aware of the deliberate attempts to elicit comprehension monitoring responses. Additionally, the difficult questions did create comprehension difficulties for the listeners, and therefore a measure of comprehension monitoring was obtained as intended. Revisions were made to

the experimental stimuli, procedures, and scoring system based on the results of this pilot study.

Subjects

Eighteen adults with TBI and 18 neurologically normal adults participated in this study. Participants with TBI were selected from the Brain Injury Unit at Alberta Hospital Ponoka (AHP). This facility accommodates approximately 60 brain injured patients, selected on the basis of rehabilitation potential. The following criteria were used to select participants with TBI for inclusion in the study.

1. Diagnosis: Medically confirmed TBI.
2. Severity: Severe TBI as predicted by initial scores of less than 9 on the Glasgow Coma Scale (Teasdale & Jennett, 1974) or as determined by the attending physician.
3. Chronicity: Longer than 8 months post-injury.
4. Background: Native speakers of English.
5. Present Functioning: Adequate speech intelligibility as determined by subjective evaluation by the investigator;
Basic language competence in expressive and receptive modalities as determined by scores on the Western Aphasia Battery (Kertesz, 1982).

The investigator administered the oral language subtests of the Western Aphasia Battery (Kertesz, 1982) to exclude any subjects with aphasia other than anomic aphasia.¹ Subjects with anomic aphasia were included because anomia is the most common linguistic impairment following TBI (Levin et al., 1976; Sarno, 1980) and does not preclude initiation and maintenance of discourse. In the WAB, the severity of language impairment

¹ Although the WAB has limited normative information, there are few other tests available with adequate psychometric data, and therefore this test is commonly used with the TBI population as a screening tool.

is summarized in a calculated "aphasia quotient." An aphasia quotient of 93.8 and above has been established as the cutoff score for nonaphasic populations. Ten participants scored above this cutoff score. The remaining eight participants scored below the cutoff score and were classified as anomic aphasic according to the criteria for classification provided in the WAB manual. Demographic information and basic medical history were obtained for all participants with TBI and are summarized in Table 1.

Table 1. Characteristics of TBI Group

<i>Subject</i>	<i>Gender</i>	<i>Age at Injury (years)</i>	<i>Mechanism of Injury</i>	<i>Time Post- Injury (months)</i>	<i>WAB (Aphasia Quotient)</i>
1	F	27	MVA*	21	80.1
2	M	35	Fall	19	94.8
3	M	40	Assault	12	97.7
4	M	51	Fall	35	94.6
5	M	19	MVA	52	96.7
6	M	23	MVA	14	99.0
7	M	36	MVA	14	97.0
8	F	39	Fall	35	94.6
9	M	23	MVA	11	98.8
10	M	58	Pedestrian hit by car	12	85.3
11	M	49	MVA	9	86.7
12	M	26	MVA	24	97.9
13	M	25	MVA	30	98.0
14	F	27	MVA	37	93.4
15	M	31	Pedestrian hit by car	36	89.1
16	M	27	MVA	9	93.0
17	M	23	Fall	17	95.4
18	M	20	Fall	9	85.6
Mean (SD)	—	32.17 (11.33)	—	22.0 (12.64)	93.21 (5.53)

* MVA = Motor Vehicle Accident

The neurologically normal participants who constituted the comparison group were recruited from hospital staff at AHP and through personal contacts. All comparison subjects were native speakers of English with the exception of one participant who learned English as a second language at the age of four. No comparison subjects had a history of head injury or neuropathology. Comparison subjects and participants with TBI were matched on the basis of race, gender, age, and number of years of formal education. Demographic characteristics of both groups are summarized in Table 2.

TABLE 2. Demographic Characteristics of TBI and Comparison Groups

<i>Demographic Variable</i>	<i>TBI Group</i>	<i>Comparison Group</i>
Gender		
Number of Males	15	15
Number of Females	3	3
Age (years)		
Range	19 – 58	19 – 53
Mean (SD)	32.17 (11.33)	31.56 (10.26)
Education (years)		
Range	8 – 15	8 – 15
Mean (SD)	11.83 (1.89)	11.89 (1.71)

Experimental Stimuli

Experimental stimuli consisted of a short topic paragraph and 40 discussion questions. The paragraph was designed to introduce the topic of discussion: speech pathology and the role of the speech pathologist (see Appendix A). This topic was chosen for two reasons. First, an uncommon topic was chosen to control for participants' background knowledge. That is, by using a topic that was assumed to be unfamiliar to the general public, participants' were required to evaluate message adequacy on the basis of cognitive-linguistic knowledge rather than on their general knowledge of the topic.

Second, this topic was selected to help maintain the investigator's credibility as a cooperative conversational partner. According to Grice (1975) conversational partners abide by a Cooperative Principle whereby each partner is expected to make relevant, appropriate, and truthful contributions to the exchange. Therefore, if the participants perceived the investigator to be deliberately flouting the Cooperative Principle, this may have altered the manner in which participants interacted with the investigator. The assumption is that participants believed that the investigator posed difficult questions because speech pathology was her field of knowledge rather than because the investigator was being uncooperative.

The discussion questions (see Appendix B) created the opportunity to elicit comprehension monitoring responses. The discussion questions used in the interaction were designed to be either easy to understand and answer (24 control questions) or difficult to understand and answer (16 experimental questions). Results from the investigator's pilot study (Hancock, 1991) indicated that a number of the questions designed to be difficult to answer did not cause comprehension difficulties for the listeners as intended. Therefore, the final set of discussion questions for the present study was selected from a larger pool of experimental and control questions based on the results of a validation study. Sixteen undergraduate university students in a department of speech pathology and audiology rated 70 potential discussion questions (32 experimental questions and 38 control questions). These students were chosen to be judges because of their advanced linguistic background which presumably contributed to stringent appraisals of the "answerability" of each question. The questions were presented orally by the investigator. After each question was read, judges rated it on a four-point successive interval scale (see Appendix C) according to how easy or how difficult it was to answer based on information content. The questions were rank ordered according to the number of judges who rated it within one point on the same half of the scale. A minimum of 15 of the 16 judges agreed

on the ratings for the 16 experimental questions and 24 control questions used as the discussion questions. This independent rating of the stimuli by competent language users served to confirm that the control questions contained sufficient information to allow formulation of an answer as intended and that the experimental questions impeded formulation of an answer as intended.

The control questions served two purposes. First, they were designed to be easy to understand and answer so that participants could engage in discussion with the investigator, making the interaction more natural. The control questions were intended to be answered based on subjects' personal ideas, knowledge or opinions regarding various aspects of speech pathology. Second, 16 of the 24 control questions were matched with the 16 experimental questions on the basis of clausal construction and sentence length (± 1 syllable). This was done in an effort to ensure that differences in length or syntactic complexity did not produce differences in participant responses and response times to both the easy and difficult questions. The remaining eight unmatched control questions were included to maintain a ratio of three control questions to two experimental questions. These questions varied freely with respect to syntax and length and were not used included in calculating any of the three dependent measures

The 16 experimental questions were designed to be difficult to understand and answer. It was hypothesized that the participants' responses to the difficult questions would provide an indication of their ability to signal comprehension breakdowns. The experimental questions were either inadequate in form (nine syntactic/pragmatic questions) or content (seven lexical/semantic questions). The two types of problematic syntactic/pragmatic questions used were ungrammatical constructions and ellipsis of single elements and phrases. Questions with lexical/semantic inadequacies employed either unfamiliar acronyms or contradictory propositions. These four experimental question types

were used in order to have a number of different types of difficult questions (see Appendix D for examples).

The basic presentation order of the experimental and control questions was randomized with the restriction that no two experimental questions of the same type be presented in succession. This was done to decrease the probability of participants detecting that inadequate questions were being used intentionally to create comprehension difficulties. The investigator created a second presentation order by reversing the first and second halves of the basic order. The two script orders were used to control for the effects of learning or fatigue on subject responses to the final discussion questions.

Procedures

Informed consent from legal guardians of those participants under guardianship was obtained prior to the experimental session (see Appendix E). Participants who were not under guardianship read and signed the informed consent form at the beginning of the experimental session to indicate their informed agreement to participate in the study and to be videotaped during the experimental session. Prior to initiating each experimental session, the investigator reminded all subjects that their participation was voluntary and discussed the purpose and use of the audio and video recordings.

Experimental Setting

Participants were tested individually in a quiet, well-lit room. All participants with TBI and the eleven comparison subjects recruited from Alberta Hospital Ponoka (AHP) staff were tested in the same clinical facility on the Brain Injury Unit at AHP. The nine comparison subjects recruited by means of personal contacts were tested in a treatment room in Corbett Hall at the University of Alberta. All participants with TBI were tested between 8:30 am and 4:00 pm in an effort to optimize their diurnal rhythm conditions.

When possible, comparison participants were tested at approximately the same time of day as their matched TBI participants.

Experimental Session

The experimental session took approximately 30 minutes. The session was videotaped and audiotaped. The investigator initiated an informal conversation prior to the experimental discussion with each subject to establish rapport and prepare for the experimental discussion.

The investigator explained the purpose of the study to each participant in a standardized presentation. In order to avoid drawing attention to the specific cognitive-linguistic skill being studied, and in an attempt to make the interaction as natural as possible, the investigator did not inform participants of the specific purpose of the study prior to the investigation. Only the general purpose of "studying how people interact with each other in a discussion" was provided.

The investigator read the instructions for the experimental session to each participant in a standardized presentation (see Appendix F). The investigator instructed participants to listen to the topic paragraph and informed them that they were not required to recall specific information from this paragraph. The investigator instructed participants to respond to the discussion questions based on their own ideas and opinions. Participants were invited to ask questions at any time during the discussion.

The investigator read the topic paragraph as an introduction to the topic of discussion and then initiated and lead the discussion by posing the discussion questions. The investigator followed an interview script which specified the order, content, and manner of presentation of the discussion questions. The first two questions were simple, unmatched control questions to initiate the discussion about speech pathology. Following these introductory questions, the remaining experimental and control questions were presented in one of two pre-determined presentation orders. The script order used was

alternated between consecutive subjects in the TBI group. Participants in the comparison group were given the same script order as their matches in the TBI group. Free-form dialogue following presentation of the discussion questions was encouraged in order to make the interaction as natural as possible. The investigator responded to participants' comprehension monitoring responses by immediate repair of the inadequate message according to a predetermined strategy. No attention was drawn to the repair or the original inadequate question.

The discussion was terminated following presentation of all 40 discussion questions. The experimental discussion was completed in one session for all but one participant. For this participant, testing was discontinued over the lunch hour and resumed immediately after lunch. At the beginning of the second session, the investigator re-read the purpose of and instructions for the session and reviewed two control questions preceding the first experimental question.

Subjects were not debriefed regarding the specific purpose of the study until all had completed it to ensure that subjects did not share this information with other potential participants. When data collection and analysis had been completed, the investigator sent a letter to all participants which explained the specific purpose of the study and the main findings (see Appendix G).

Standardization of Procedures

The following precautions were taken in order to reduce the risk of error due to nonstandardized presentation of the stimuli by the investigator during data collection. An audio-tape of the investigator reading all experimental questions and their matched control questions was made to establish prosodic standards for stimuli presentation during data collection. This was accomplished by comparing the investigator's speaking rate, pauses, and stress patterning across three trial audio recordings of stimuli presentation to a real listener. The most representative recording was used as the "calibration tape." The

suprasegmental features of this recording were marked on the interview scripts which the investigator followed during the experimental sessions. Overall stress patterning was transcribed using stress markings to indicate the prominent words within each utterance. Breath groups within each question were marked with slashes to indicate phrasing. The duration of each question and the overall speaking rate for the calibration tape was also determined from the audiotaped stimuli. The investigator rehearsed these features of her presentation with the calibration tape prior to periods of data collection.

This information also provided a standard against which actual stimuli presentation during data collection was compared. Question duration was measured and overall speaking rate was calculated for a random 20% of the experimental sessions. Results of these measurements are summarized and compared to normative data in Table 3.

TABLE 3. Mean Speaking Rate (words/minute) of Seven Experimental Sessions

<i>Calibration Tape</i>	<i>Experimental Sessions</i>	<i>Normative Information</i>
162.6 (20.68)	167.0 (8.13)	Sentence Reading: 190*
		Conversation: 150–250**

* Yorkston & Beukelman, 1981

**Goldman-Eisler, 1968

Data Analysis

Scoring

The three dimensions of comprehension monitoring that constituted the dependent measures were response time (milliseconds), frequency (number of responses), and form (type of verbal response) of comprehension monitoring responses.

Response times for both experimental and control questions were measured from the end of the investigator's presentation of the question to the initiation of the participant's verbal response to that question. Fillers such as "uh" or "um" were not counted as the first

verbal response. The time elapsed between all questions and responses was measured from a digital waveform display of the sound track of the videotape of each experimental session. The sound track was digitized via an analog-to-digital converter (Data Translation 2821), and displayed, edited and measured via CSpeech software (version 3.1; Milenkovic & Read, 1990) on an IBM-286AT computer. The investigator referred to the videotape to isolate the pertinent portions of the sound track for digitization; the portion digitized was confirmed as appropriate via the digital-to-analog playback option in CSpeech. Two cursors were used by the investigator to mark the end of the waveform display corresponding to the investigator's questions and the onset of the waveform corresponding to the subject's first verbal response; the CSpeech software automatically computed the time between the cursors, and this value was visible on the waveform display.

A comprehension monitoring (CM) response was defined for purposes of this study as a verbal or nonverbal behavior that signals a listener's awareness of information inadequacies in a message he has heard. Verbal responses that were scored as signaling the listener's awareness of information inadequacies were repetitions or restatements of the question, nonspecific requests for clarification which indicated general comprehension difficulty, specific requests for clarification which identified the source of the comprehension difficulty, and proposals of possible interpretations of a question's meaning. Verbal responses that were considered to indicate the listener's failure to detect message inadequacies were labelled as "non-CM responses." The three types of responses included in this category are defined as follows: "no response," the absence of any verbal or nonverbal response to an experimental question; "error responses," answers to experimental questions which do not signal comprehension difficulties; "inadequate responses," answers to experimental questions which attribute comprehension difficulties to the listener's lack of knowledge rather than to the internal inadequacies in the form or content of the question (e.g., "I don't know").

Nonverbal responses were scored as CM responses only in the absence of any verbal CM response. This was done because verbal responses are more explicit indicators of comprehension breakdown than nonverbal responses. That is, because nonverbal responses are difficult to unequivocally interpret on-line, the investigator did not respond to nonverbal requests for clarification unless no verbal response was provided. Nonverbal responses which were scored as indicating the listener's response to a question included body movements (e.g., head nodding) and hand gestures.

The frequency of comprehension monitoring responses was calculated by tallying the number of verbal CM responses to the experimental questions and their matched control questions.

The form of verbal CM responses was classified according to the taxonomy given in Table 4. The four categories used to classify the CM responses were derived from Garvey (1977) and McTear (1985). These categories of CM responses are considered to be hierarchical in terms of the explicitness with which the trouble source within an inadequate message is indicated. The types of verbal responses within each category are based on the types of repair initiators proposed by Schegloff et al. (1977) and from pilot and actual data collection for the present study. In cases where a participant provided more than one type of verbal CM response, the most explicit type of response was recorded; that is, the one falling at the highest point in the hierarchy. This was done to obtain an estimate of each participant's optimal performance.

TABLE 4. Verbal CM Response Classification

1. Nonspecific Repetition

An repetition or restatement of all or nearly all of a question.

- (a) *Repetition or restatement of a portion of a question:* a clause (group of words containing a subject and predicate) from a question is repeated.

For example:

Q: If speech pathologists can work with people of all ages, why can they only work with children?

A: Why can they?

- (b) *Repetition or restatement of an entire question:* an entire question is repeated or rephrased.

For example:

Q: If communication disorders are common why are they rare?

A: If they're common why are they rare?

2. Nonspecific Requests for Clarification

An utterance that indicates general comprehension difficulties with a question.

- A short utterance indicating comprehension difficulties (e.g., "Pardon" or "Huh").
- A statement regarding the subject's level of understanding (e.g., "I don't understand" or "I missed that").
- A request for repetition of an entire question (e.g., "Could you say that again").
- A request for explanation of an entire question (e.g., "Explain that question").

3. Specific Request for Clarification

An utterance that indicates comprehension difficulty with specific part of a question.

- (a) *Implicit Request for Clarification:* repetition of a word or phrase (group of two or more grammatically related words) from a question, indicating that a certain aspect of a question has been misunderstood.²

For example:

Q: Why would a speech pathologist really try that a treatment program of a client would complete?

A: Why would a ...?

² Response type 3a (implicit request) is differentiated from response type 1a (partial repetition) as follows. Repetition of an incomplete portion of a question (i.e., 3a) highlights the trouble source within the question whereas repetition of a complete segment of a question (i.e., 1a) does not specify what aspect was difficult to understand. Such repetitions may not even function as requests for clarification. Corsaro (1977) proposed that in the social context of adult-child speech simple repetitions may serve to mark acknowledgment of the message rather than as a request for clarification.

(b) *Explicit Request for Clarification:*

- Request for repetition of a specific part of a question plus an interrogative.

For example:

Q: Do you think damage to the RLN would affect speech?

A: Damage to the what?

- A request for elaboration of a specific portion of a question.

For example:

Q: When do you think a speech pathologist is responsible?

A: Responsible for what?

- Questioning or correcting the veracity or adequacy of a question.

For example:

Q: If speech pathologists can work in many different settings, why can they only work in schools?

A: They don't only work in schools.

4. Proposal of an Interpretation

An implicit request for clarification is made by proposing a possible interpretation of an inadequate question.

For example:

Q: Do you think that a speech pathologist should always repeat?

A: What they say?

Reliability

To determine interjudge reliability for response time, a second judge measured a random selection of 10% of the experimental and control questions. For the calculation of point-to-point reliability, agreement was defined as a difference of no more than ± 100 milliseconds between the first and second measurements. Interjudge reliability was 86% (95/110 items). The remaining items differed by 104 to 306 milliseconds. To establish intrajudge reliability, the investigator remeasured a random selection of 10% of the experimental and control questions following a minimum two week interval since the first scoring. Point-to-point agreement was defined similarly for intrajudge reliability and was found to be 95% (105/110 items). The difference in response times for remeasurement of the remaining five items ranged from 102 to 169 milliseconds.

To establish interjudge reliability measures for frequency of CM responses, a second judge scored a random selection of 10% of subject responses to the experimental

and control questions. Point-to-point interjudge reliability was calculated by dividing the total number of agreements by the total number of agreements and disagreements (McReynolds & Kearns, 1982) and was found to be 98%. The investigator rescored a random selection of 10% of the control and experimental questions following a minimum two week interval since the first scoring. Point-to-point intrajudge reliability was 98%.

To determine interjudge reliability for form of CM responses, a second judge scored a random selection of 10% of CM responses to experimental questions. Cohen's kappa was used to calculate percent agreement (Bakeman & Gottman, 1986). This statistic corrects for chance agreement by computing the proportion of agreement actually observed minus the proportion of agreement expected by chance alone. Kappa values of .75 and over are considered to represent excellent agreement (Fleiss, 1981). The kappa value for interjudge agreement on form of CM responses was .80. The investigator rescored a random selection of 10% of CM responses following a two week interval since the first scoring. The kappa value for intrajudge agreement on form of CM responses was .97.

Statistical Analysis

This was a comparative study with two independent variables and three dependent variables. The two independent variables were subject group and stimulus type. Subject group had two levels: subjects with TBI and neurologically normal subjects matched to the brain-injured subjects according to four demographic variables (age, race, gender, and years of education). Stimulus type had two levels: control and experimental.

The three dependent variables were response time, frequency, and form of CM responses. Appropriate descriptive statistics including means, standard deviations, and percentages were used to describe subjects' responses in terms of response time, frequency, and form of CM responses.

Response time data were analyzed using participants' mean response times in milliseconds to the experimental and matched control questions to compute a two-factor analysis of variance with repeated measures on group.

Frequency of CM responses was analyzed using the mean number of CM responses to experimental and matched control questions for each subject group to compute a two-way analysis of variance with repeated measures on group.

The form of verbal comprehension monitoring responses was analyzed using the mean percent of verbal responses in each of the four categories of verbal CM responses (nonspecific repetition, nonspecific request for clarification, specific request for clarification, proposal of possible interpretation). Each percent was based on the number of responses in the category divided by the total number of CM responses to the experimental questions. Proportions of CM responses were used rather than number of responses to adjust for the different number of total CM responses given by the two groups. These data were transformed using the arcsine transformation (Kirk, 1968) to stabilize error variance. The mean percents of each response type produced by the two groups were compared using t-tests for independent samples.

An assumption underlying the use of an analysis of variance is that the variance of all groups in the analysis is equivalent. The results may be distorted if variances are different (Kerlinger, 1973). Tests for homogeneity of variance were performed prior to computing the analyses of variance for the frequency and response time data. Based on the results of the Cochran Bartlett Box M test for homogeneity of variance, the assumption of homogeneity of variance was not met (frequency of response for control questions: $F = 1.13$; $df\ 1, 3468$, $p < .05$; frequency of response for experimental questions: $F = 8.64$; $df\ 1, 3468$, $p < .05$; response time for control questions: $F = 17.18$; $df\ 1, 3468$; $p < .05$; and response time for experimental questions: $F = 4.73$; $df\ 1, 3468$; $p < .05$). Visual inspection of the data revealed that the TBI group had greater variability in performance

than the comparison group. However, Huck, Cormier and Bounds (1974) report that "the F test is robust to violations of the homogeneity of variance assumption provided that the number of scores in the groups is the same" (p. 66). Therefore, while the results must be interpreted with caution, the F test is assumed to be valid in consideration of the balanced sample sizes employed in the analyses.

Chapter 4 • Results

Statistical Analysis

The results of the statistical analyses of the three dependent measures are presented in this section. All descriptive and inferential statistical analyses were completed using the SPSS/PC Version 4.0 computer software program (Norusis, 1990).

Response Time

The first research question was: Do participants with TBI differ from comparison subjects in the time required to respond to the discussion questions?

A two-way factorial design was used with group (TBI and comparison) as one factor and stimulus type (experimental and control) as the other. The analysis of variance with repeated measures on group yielded results indicative of nonsignificant differences ($p > .05$). The group means and standard deviations are included in Table 5.

TABLE 5. Group Means and Standard Deviations for Response Time (msec)

<i>Stimulus Type</i>	<i>TBI Group</i>		<i>Comparison Group</i>	
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>
Experimental	3052.18	1565.65	2631.19	905.51
Control	2899.41	1913.35	2333.65	632.29

Figure 1 illustrates the mean response times in milliseconds for both groups to respond to the control questions and the experimental questions.

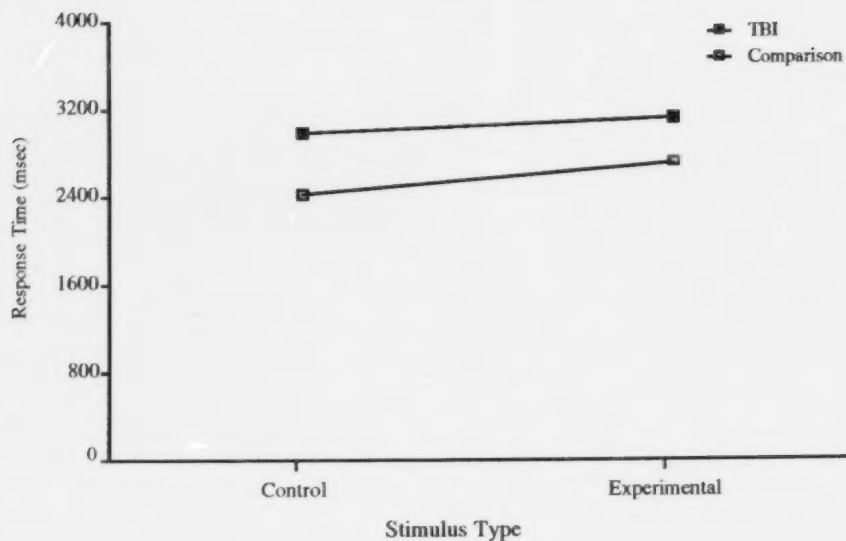


FIGURE 1. Mean Response Time

Frequency of CM Responses

The second research question to be answered was: Do participants with TBI differ from comparison subjects in the frequency with which comprehension difficulties are signalled?

The means and standard deviations for the number of CM responses and non-CM responses to both experimental and control questions are presented in Table 6. Only the responses to the experimental questions were analyzed further according to the type of CM or non-CM response.

TABLE 6. Group Means and Standard Deviations for the Number of Responses

<i>Response Type</i>	<i>TBI Group</i>	<i>Comparison Group</i>
I. Control Questions		
CM Responses	0.89 (1.28)	1.78 (1.66)
Non-CM Responses	15.11 (1.28)	14.22 (1.66)
II. Experimental Questions		
CM Responses	9.44 (3.94)	12.89 (1.84)
Verbal	9.38	12.83
Nonverbal	0.06	0.06
Non-CM Responses	6.56 (3.94)	3.11 (1.84)
No Response	0.17	0.00
Error Response	5.11	2.78
Inadequate Response	1.28	0.33

A two-way analysis of variance was used with group (TBI and comparison) as one variable and stimulus type (experimental and control) as the other. The results of the analysis of variance with repeated measures on group revealed that there was a main effect for stimulus type with more CM responses given in reply to the experimental questions than to the control questions ($F = 303.3$; $df\ 1, 34$; $p < .01$). There was a main effect for group with participants in the comparison group providing more CM responses than the TBI group ($F = 14.22$; $df\ 1, 34$; $p < .01$). There was also an interaction between group and stimulus type ($F = 5.12$; $df\ 1, 34$; $p < .05$).

Figure 2 illustrates the mean number of CM responses given by the two groups in response to the two types of stimuli. These data are displayed in Table 6.

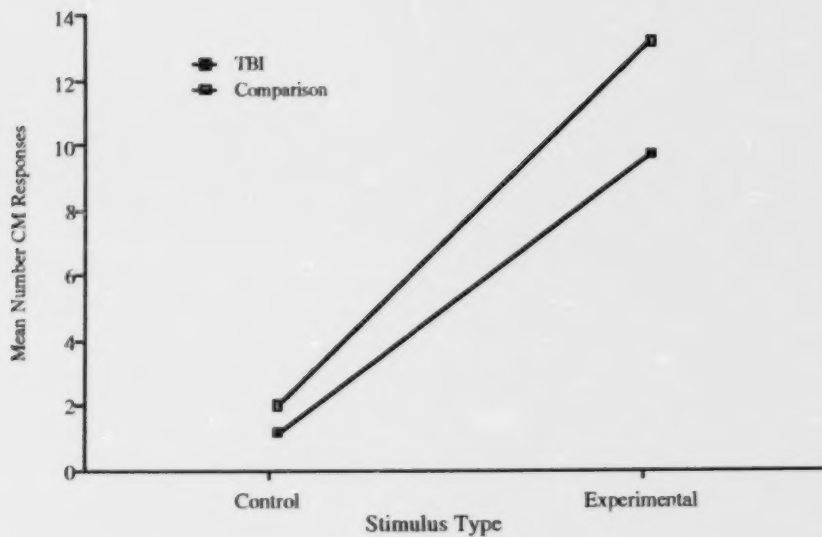


FIGURE 2. Mean Number of CM Responses

Both groups provided fewer CM responses to the control questions than to the experimental questions. This suggests that the control questions were easy to answer as intended. The higher number of CM responses to the experimental questions was expected because the experimental questions were designed to be more difficult to answer in order to elicit CM responses. The participants in the TBI group produced significantly fewer CM responses in reply to the experimental questions than did the participants in the comparison group. In order to investigate whether language abilities of participants in the TBI group were related to their ability to comprehension monitor, participants' WAB scores were correlated with the number of CM responses they produced in reply to the experimental questions. A positive correlation (Pearson $r = .59$; $p < .01$) was found between these two factors. This suggests that there is a relationship between comprehension monitoring skills and language skills.

Form of CM Responses

The third research question was: Do participants with TBI differ from comparison subjects in the form of verbal CM responses used to signal comprehension difficulties?

Recall that only the most explicit type of CM response (i.e., highest on the hierarchy) provided by participants was scored as the CM response. The mean proportions of each response type produced as the "highest" CM response by the two groups were compared using *t*-tests for independent samples. Results of these comparisons are displayed in Table 7.

TABLE 7. Group Means, Standard Deviations and *t* values for Proportions of the CM Response Types

<i>Response Type</i>	<i>TBI Group</i>		<i>Comparison Group</i>		<i>t</i>
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	
1	0.05	0.11	0.07	0.08	-.30
2	0.24	0.17	0.20	0.13	.74
3	0.51	0.18	0.56	0.12	-1.00
4	0.06	0.11	0.14	0.11	-2.09*

* $p > .05$.

Figure 3 illustrates the mean proportions of each response type produced by both groups. There is a similar pattern in the frequency with which each response type was used by the two groups. Type 3 responses (specific requests for clarification) were used most frequently as the "highest" CM response by both groups, followed by type 2 responses (nonspecific requests for clarification) and type 4 responses (proposals of interpretation). Type 1 responses (nonspecific repetitions) were used least often as the sole response by both groups.

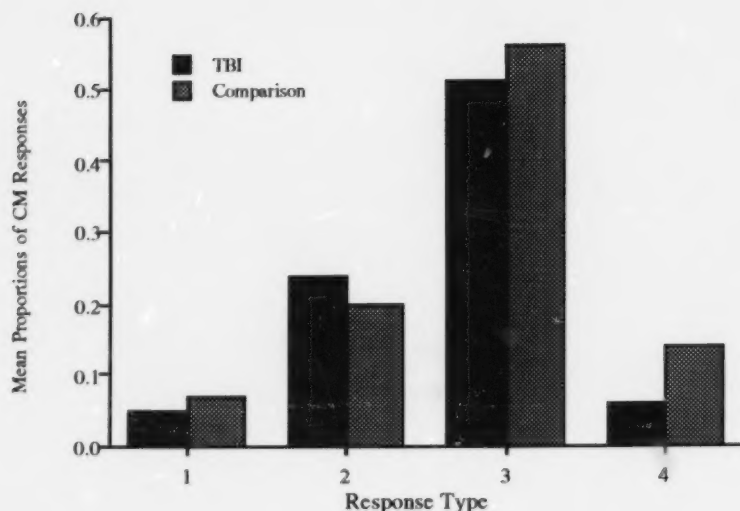


FIGURE 3. Mean Proportions of the Four CM Response Types

“Inadequate” responses (e.g., “I don’t know”) were classified as non-CM responses and were defined as listener responses to experimental questions which attribute comprehension difficulties to his/her own inadequate knowledge base rather than internal inadequacies in the question. Because the TBI group appeared to use more “inadequate” responses than the comparison group, a *t*-test for independent samples was used to compare the mean proportions of this response type produced by the two groups. A significant difference was found between the proportions of non-CM responses employed by the two groups; the participants in the TBI group produced more “inadequate” responses than the participants in the comparison group ($t(34) = 2.66, p < .05$). Although this response form could not be classified as a CM response, it may represent a strategy used by the TBI group to respond to inadequate messages.

Descriptive Analysis

The results presented in this section are descriptive in nature. Inferential statistics were not used because of the small number of data. Rather, visual display of group means are presented to explore some additional findings about comprehension monitoring obtained in this study. Specifically, the three dependent measures are considered in relation to the four types of experimental questions: elliptical, ungrammatical, contradictory and acronyms.

Response Time

Figure 4 demonstrates the mean response time of each group according to question type.

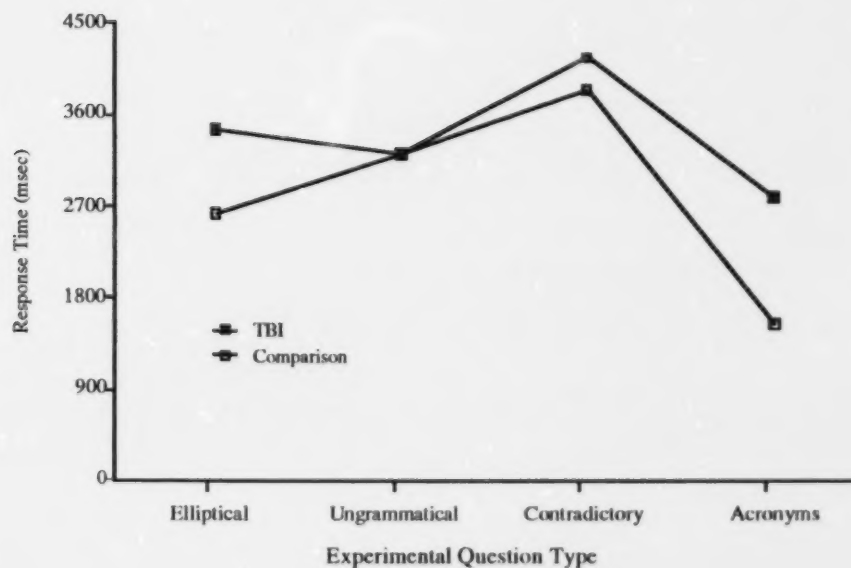


FIGURE 4. Mean Response Time for the Four Types of Experimental Questions

For both groups, the shortest response times occurred on the questions with acronyms.

Response times were longest for the questions that contained contradictions.

Frequency of CM Responses

Figure 5 illustrates the mean number of CM responses produced by the two groups relative to the four types of experimental questions. Because no statistical analysis was completed, the data displayed below represent the proportion of CM responses per type of experimental question.

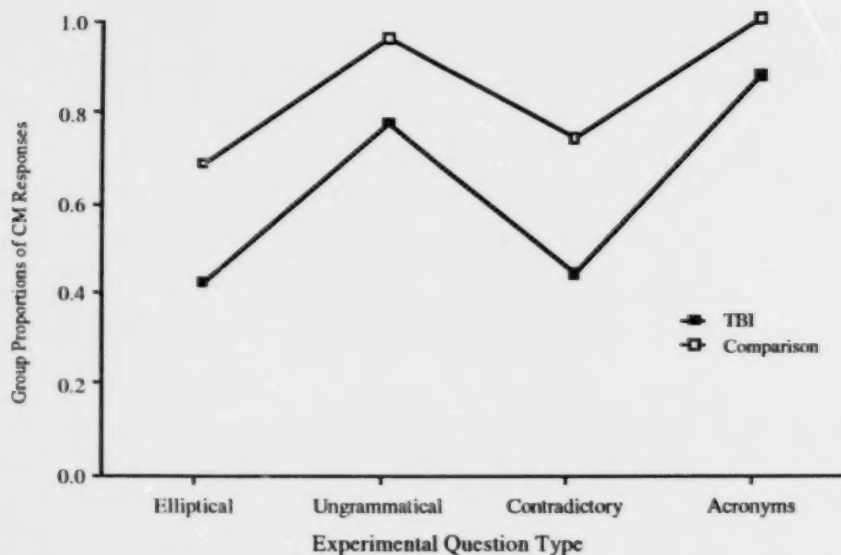


FIGURE 5. Group Proportions of CM Responses and the Four Types of Experimental Questions

This figures indicates that both groups responded to the four types of questions in similar ways. Both groups signalled comprehension difficulties more frequently for the ungrammatical questions and the questions containing acronyms; both groups signalled comprehension difficulties less frequently for the contradictory and elliptical questions.

Form of CM Responses

Figure 6 illustrates the frequency with which each response type was used with each type of experimental question. The data displayed below represent the proportions of each type of CM response given by the group. These proportions were computed individually for the four experimental question types.

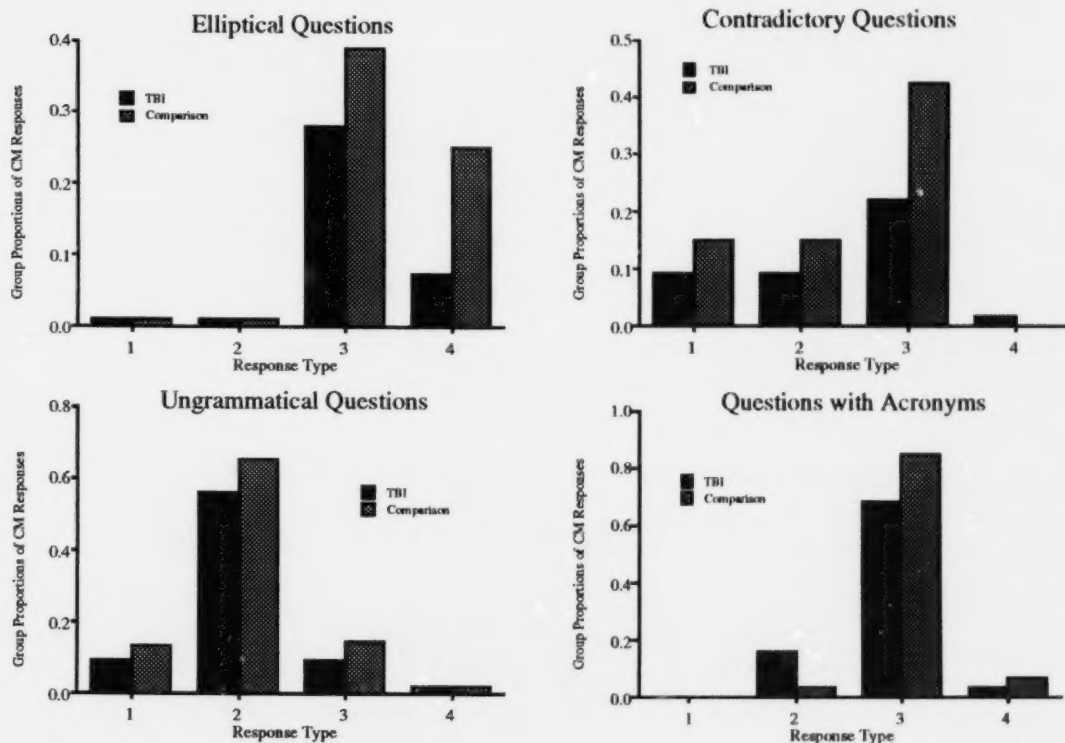


FIGURE 6. Group Proportions of Each Response Type and the Four Types of Experimental Questions

Both groups demonstrated similar patterns for the response types used with each question type. Both groups produced primarily type 3 (specific request for clarification) and type 4 (proposal of interpretation) responses to indicate comprehension breakdowns for elliptical

questions. The comparison group produced more than twice as many type 4 responses as the TBI group did. Both groups used primarily type 2 responses (nonspecific request for clarification) to signal comprehension difficulties with the ungrammatical questions. For the contradictory questions, response types 1 (nonspecific repetition), 2 (nonspecific request for clarification) and 3 (specific request for clarification) all were used by both groups. However, the comparison group used almost twice as many type 3 responses as the TBI group did. Finally, for the questions containing acronyms, both groups provided type 3 responses (specific request for clarification) most frequently.

Chapter 5 • Discussion

A number of interesting findings have emerged from this investigation of comprehension monitoring in adults with TBI. Specifically, the TBI group signalled comprehension difficulties less often than the comparison group. The TBI groups also used fewer type 4 CM responses (proposal of interpretation). In the following section, the findings for each of the three dependent measures are discussed individually.

Response Time

Response time was included as a dependent measure based on the assumption that participants would require additional processing time to detect and react to inadequacies in the experimental questions; that is, to comprehension monitor. Therefore, a difference between response times for the experimental and control questions was expected. In the data of the present study, however, there were no significant differences in mean response time between the two groups nor between the two stimulus types (experimental and control questions).

The most obvious explanation for the nonsignificant results is that the two types of questions, experimental and control, did not require processing time that was remarkably different. That is, notwithstanding the intended difference between the control and experimental questions for ease of answering, it may not have taken any longer to process the experimental than the control items.

A second possible explanation for the nonsignificant results is that mean data in Table 6 and Figure 1 may have masked the fact that response time varied according to the type of message inadequacy used to elicit CM responses. That is, the speed with which message inadequacies were detected varied across the four types of experimental questions. Figure 4 illustrates that participants typically signalled comprehension difficulties to the

ungrammatical questions and questions containing acronyms very quickly while responses to the elliptical and contradictory questions were generally slower.³ Baker (1984) claimed that the detection of message inadequacies during reading is a "multidimensional process, requiring the use of a variety of standards or criteria against which to evaluate one's comprehension" (p. 290). For example, in order to detect difficult vocabulary items (i.e., acronyms), readers employ a lexical standard of evaluation to ensure that each word is within their vocabulary. Baker suggested that different standards of evaluation "impose different processing demands on the subject and so are likely to differ in their ease of application" (p. 291). Presumably, standards of evaluation similar to these used during reading comprehension would also be employed during listening comprehension. Because different types of message inadequacies were presented in this research, listeners were required to employ different standards of evaluation which may have produced variability in their response times. Therefore, response time may have been a more informative dependent measure of comprehension monitoring if the types of experimental questions presented were more homogeneous with respect to the standards required to evaluate message adequacy.

A third possible explanation for the nonsignificant difference in mean response times between stimulus type (control and experimental) is that because an interactive, discourse level task was used to study comprehension monitoring, response time measured something more generic than just detection of message inadequacy. Although basic clausal construction and sentence length were equivalent between each experimental question and its matched control question, this does not guarantee equivalence in terms of conceptual complexity. Discourse level speech requires coordinated use of participants' linguistic and social competence (Goodwin, 1981). Linguistic competence includes knowledge of the

³ No statistical analysis of these data was completed because of the small and unequal number of data points.

formal rules of language and functional knowledge of how to use language within context. Social competence includes the ability to interact cooperatively and to make contributions to the interaction that are appropriate within a given setting. Therefore, response time may have reflected the overall linguistic and social processing demands of the experimental task rather than the detection of message inadequacies per se. Because these overall processing demands would be operative for both groups of subjects and both kinds of questions, significant differences in response time to experimental questions due to message inadequacies may not have been detectable.

Response time did not prove to be a discriminating outcome measure of comprehension monitoring between subjects or stimuli given that a discourse level task using a wide range of inadequate message types to elicit CM responses was employed.

Frequency of Responses

The second outcome measure provides an indication of the frequency with which participants signalled comprehension difficulties. As expected, stimulus type influenced the frequency with which participants provided CM responses. Specifically, both groups provided fewer CM responses for the control questions which were designed to be easy to understand and answer. Conversely, both groups signalled communication breakdowns more frequently for the experimental questions which were designed to be difficult to understand and answer.

Differences between the groups in the frequency of CM responses were identified. The TBI group signalled comprehension difficulties less frequently overall than the comparison groups. Further, the TBI group produced significantly fewer CM responses to the experimental questions than the comparison group. These findings lend support to the hypothesis that because there is a predilection for the executive system to be damaged following TBI, the metacognitive skill of comprehension monitoring may be impaired.

Stuss (1992) proposes that the primary role of the executive system is "the conscious direction of the lower level systems toward a selected goal" (p. 11). He suggests that executive control may be "divided into specific functions such as anticipation, goal selection, plan formulation, evaluation and monitoring of behavior..." (p. 12). The results of this study suggest that evaluation and monitoring of listening comprehension may indeed be disrupted following TBI. The executive functions are also referred to as "frontal lobe functions" because the frontal lobes are the anatomical loci of executive control. Stuss (1992) claims that because the frontal lobes work in coordination with other areas of the brain, the term "frontal systems" more accurately reflects the interactive, integrative functions of the frontal lobes with other areas of the brain. Consistent with this approach, Stuss and Gow (1992) report that diffuse brain damage which typically accompanies severe TBI can produce frontal dysfunction even without localized damage to the frontal lobes. These authors propose that frontal dysfunction may be the primary disorder in TBI. The results of this study are consistent with this claim.

In addition to these group differences in frequency of response, it is also important to consider within-group variability. Results of the tests for homogeneity of variance performed on the group data for response time and frequency of response indicated that the scores in each of the groups differed with respect to variance. Inspection of the data reveals that the TBI group had greater variability in performance than the comparison group. The total number of CM responses provided by participants with TBI ranged from 3/16 to 15/16; the number of CM responses provided by participants in the comparison group ranged from 9/16 to 15/16. The positive correlation found between language ability and frequency of CM responses accounts for some of this variability. It appears that better oral language abilities may be associated with greater tendency to use comprehension monitoring skills. This is consistent with our understanding of comprehension monitoring

as involving both linguistic and cognitive skills in the detection of and reaction to message inadequacies.

Similarities between the groups were found based on qualitative analysis of the data. Specifically, both the TBI and comparison groups signalled comprehension difficulties most frequently for the experimental questions with acronyms and ungrammatical constructions and least often for the elliptical and contradictory questions.

This finding can be interpreted in two ways. First, frequency of response may have been related to the amount of processing required to detect message inadequacies in the four types of experimental questions. Detection of difficult lexical items and unacceptable syntactic constructions requires basic linguistic knowledge and therefore minimal processing. Markman (1981) claims that "even young children should be able to determine that they did not understand rapid or garbled speech, speech in a foreign language, completely ungrammatical speech, or extremely complex sentences. Minimal processing is required for such judgments" (p. 68). However, the detection of contradictions and missing propositions requires more active processing to detect internal inconsistencies and incomplete utterances. Markman notes that "insufficient processing precludes access to information needed for judging one's comprehension" (p. 74). Unless listeners processed the experimental questions with adequate effort, message inadequacies may have gone undetected. Therefore, those types of experimental questions requiring additional processing were not detected as frequently as those requiring minimal processing.

A second explanation is that the difference in frequency of response by experimental question type was related to the ease with which interpretations of the investigator's meaning could be formulated. Markman (1981) claims that people are continually forming inferences and expectations for incoming messages. She notes that "it could be that for each of these inferences we momentarily suspect a problem but suspend

concern as soon as an inference resolves it" (p. 69). It may be difficult to construct a plausible meaning for unfamiliar acronyms or syntactically unacceptable, and therefore semantically meaningless, utterances. Indeed, few participants attempted to interpret the meaning of these types of experimental questions. However, for the elliptical questions, a listener may be able to supply missing details and formulate an answer based on the available contextual information. Participants frequently did formulate answers to the elliptical questions rather than signal comprehension difficulties. Similarly, participants frequently appeared to overlook the internal inconsistencies within the contradictory questions and provided an answer to only one of the propositions in the question. Therefore, explicit CM responses may have been provided less frequently to experimental questions for which interpretations could be easily formed.

These two explanations represent two different approaches as to why the questions with acronyms and ungrammatical constructions were reacted to more frequently than elliptical and contradictory questions. The first explanation states that the elliptical and contradictory questions were not detected as frequently because additional processing effort was required to detect the missing propositions and logical inconsistencies. Therefore, if inadequate processing effort was used, listeners would fail to detect these message inadequacies. The second explanation states that the elliptical and contradictory questions were detected but because inferences could be easily formulated for these experimental questions, interpretations of the message were given more frequently than indications of comprehension difficulties. Based on the results of this study, it is impossible to know which of these explanations best describes the process of comprehension and comprehension monitoring in a group of adult listeners.

Form of CM Responses

The third outcome measure was designed to quantify the manner in which participants signalled comprehension difficulties. The two groups differed in terms of the frequency with which type 4 responses (proposal of interpretation) were produced. The comparison group used these repair types more frequently than the TBI group. Seven of the participants in the TBI group provided at least one type 4 response while 15 of the participants in the comparison group used this CM response at least once. This response type is the highest on the hierarchy of repair initiators. Participants who produced this response type went beyond identifying the trouble source to proposing a possible meaning for the inadequate question. Presumably, this form of response requires additional conceptual processing to detect message inadequacies and then to propose a tentative modification of the trouble source that is consistent with the speaker's original question. This response type implies active listener participation in the repair of communication breakdowns whereas the less specific repair types (i.e., types 1 and 2) require the speaker to assume greater responsibility for identifying the trouble source and modifying the message appropriately.

Another interesting difference between the groups was that the TBI group provided significantly more "inadequate" non-CM responses (e.g., "I don't know") to the experimental questions than the comparison group. This appears to parallel the development of comprehension monitoring in children. Young children have been found to attribute comprehension breakdowns to inadequacies in the listener rather than inadequacies in the speaker's message (Meline & Brackin, 1987). Therefore, this response may represent a rudimentary reaction to inadequate messages.

In addition to the aforementioned differences, there were also similarities between the groups in the form of CM responses used to signal comprehension difficulties. Both

groups used similar proportions of type 1, type 2, and type 3 responses. Type 3 responses (specific request for clarification) were used most frequently by both groups, followed by type 2 responses (nonspecific request for clarification). Type 1 responses (nonspecific repetition) were used least often by both groups. This finding may be interpreted as support for the claim that the repair types are hierarchical in terms of the explicitness with which the trouble source within a message is located. Perhaps participants used the more explicit CM responses (i.e., type 3) more frequently because these repair initiators facilitate effective identification of the trouble source and thereby efficient speaker repair of the message. Conversely, the least specific CM responses (i.e., type 1) may have been used less frequently because this response type provides limited information regarding what aspect of the message needs to be repaired, and therefore speaker repair may be less effective.

Based on descriptive analysis of the data, there appears to be an additional factor involved in the selection of repair initiators. Specifically, the type of message inadequacy appears to elicit a particular type of repair initiator. The two groups used similar repair initiators to respond to each of the four types of experimental question. Ungrammatical questions were answered primarily using type 2 responses. These nonspecific requests for clarification may be the most explicit repair initiator participants could use given that there was no single, identifiable trouble source within the ungrammatical questions. Rather, the form of the entire utterance violated syntactic rules and resulted in semantically meaningless questions. Participants responded to questions with acronyms using type 3 responses. Participants readily detected the difficult vocabulary items within the questions and were able to request specific clarification for the unfamiliar acronyms. Elliptical questions elicited a large number of type 3 responses from both groups and a number of type 4 responses from the comparison group. Type 4 responses (proposal of interpretation) may be the most logical response to an incomplete utterance. That is, participants appeared to detect that a segment of the question was omitted and propose a tentative interpretation of

the investigator's meaning. Repair initiators for the contradictory questions included a large number of type 3 responses as well as a number of type 1 and type 2 responses. The wide range of response types produced in reply to the contradictory questions suggest that some participants failed to identify the internal inconsistencies within the question and requested nonspecific clarification while others detected these inconsistencies and requested specific clarification of the contradictory propositions contained in the questions. Because there was a correspondence between the type of experimental question and the type of CM response, it may be that question type elicits certain response types. Therefore, while response types may be hierarchical in terms of reparative power, they appear to interact with a hierarchy of question type.

Chapter 6 • Conclusion

The purpose of this study was to investigate whether adults with TBI differ from neurologically normal adults in their ability to comprehension monitoring. Based on the results of this study, three conclusions can be drawn.

The first conclusion is that, as a group, participants with TBI differed from the comparison group in their ability to monitor their comprehension of spoken language. There were significant differences in the frequency and form with which comprehension difficulties were signalled by the two groups. Therefore, comprehension monitoring may be disrupted following TBI.

The second conclusion is that the differences in comprehension monitoring skills of the two groups appear to be quantitative in nature rather than qualitative. The two main differences between the two groups related to the number of CM responses provided. First, the TBI group provided significantly fewer requests for clarification than the comparison group. Second, the TBI group produced fewer of the highest form of CM responses (i.e., type 4) than the comparison group.

Similarities in comprehension monitoring skills of the two groups provide support for the conclusion that the groups did not differ qualitatively. First, both groups responded differentially to the experimental and control questions: both groups provided few CM responses to the control questions and significantly more CM responses to the experimental questions. This indicates that the TBI group found the same types of questions easy to answer and difficult to answer as the comparison group. Second, the TBI group was capable of using the same range of CM response types as the comparison group. All four of the CM response types were used by the TBI group. The TBI group used the same proportions of type 1, type 2, and type 3 CM responses as the comparison group. Participants in the TBI group also used type 4 responses; however, fewer type 4 responses

were produced by a smaller proportion (7/18 subjects) of the participants in the TBI group relative to the comparison group (15/18 subjects). In general, the kinds of CM responses used to signal comprehension breakdowns were similar between the two groups. Third, the TBI group was able to detect and react to the same range of inadequate experimental questions as the comparison group. Both groups reacted to the questions with acronyms and ungrammatical constructions with a CM response more frequently than the contradictory and elliptical questions. This suggests that the TBI group used the same types of linguistic and conceptual processing to detect message inadequacies as the comparison group. Fourth, the TBI group reacted to the four types of experimental questions in approximately the same way as the comparison group. The two groups used similar types of CM responses to reply to the questions with acronyms, ungrammatical constructions and contradictions; however, the TBI group produced fewer type 4 responses for the elliptical questions than the comparison group.

As a group, participants with TBI produced fewer CM responses. However, the TBI group was capable of producing the same range of CM responses in reply to the same range of inadequate question types as the comparison group. This finding suggests that basic comprehension monitoring skills seemed to be preserved in the participants with TBI in this study, although they exhibited their competence with comprehension monitoring less frequently or reliably than the comparison subjects.

The final conclusion drawn from this study relates to the process of comprehension monitoring in general. Based on qualitative analysis of the response types produced for each experimental question type, both groups produced certain response types in reply to certain question types. The type of message inadequacy seems to be an additional factor that influences both the probability of detection of and the form of reaction to inadequate messages. Therefore, any discussion about the form of CM responses used to react to

message inadequacies should make reference to the type of message used to elicit the CM responses.

Implications for Clinical Practice

The results of this study have both general and specific implications for clinical practice. In general, the findings suggest that comprehension monitoring may be impaired following TBI and, therefore, members of rehabilitation teams who work to facilitate maximal recovery of independence and eventual reintegration into society should be aware that communication may be jeopardized by impairments in comprehension monitoring. Following identification of this impairment, measures could be taken to alleviate communication breakdowns and misunderstandings that may adversely affect a client's personal and professional relationships.

A second general implication for speech-language pathologists is that the findings serve to highlight the importance of the listener's role in communicative interactions. Traditionally, the focus of research and intervention with communication disorders has been on the client as "speaker" with less attention to the client as "listener." Humphreys-Jones (1986) poses two explanations to account for this speaker-oriented bias. First, it is indeed the speaker who contributes the substance of conversation. The focus in studies of communication is naturally drawn to the source of proposition conceptualization and utterance production. The listener appears to be a passive recipient of the speaker's utterances. Second, methodologically, it is much easier to identify and modify the behavior of the speaker as opposed to that of the listener. The speaker produces tangible utterances which can be analyzed in detail. Listener processes, however, are covert and much more difficult to evaluate and modify.

The role of listener, however, is equally important to that of speaker: "The hearer, in endeavouring to understand the utterance correctly, is engaged in a highly complex

cognitive process which has crucially important linguistic, social and psychological consequences for the development of the conversation" (Humphreys-Jones, 1986, p. 106). The data collected for the present study indicate that the neurologically normal participants, and the participants with TBI less frequently, actively monitored their understanding of incoming messages and frequently signalled comprehension difficulties with inadequate messages. Although the investigator's role as speaker was contrived in this experimental task, the participants' role as listener is presumably representative of how actively listeners can participate in communicative interactions. Humphreys-Jones (1986) claims that "successful communication requires speakers and hearers to monitor their intentions and understandings as an integral part of the communication process" (p. 125). Therefore, it is important for adults with TBI to be active listeners and thereby assume responsibility for identifying their own comprehension breakdowns to facilitate effective communication with others. Successful communication is fundamental to the success of both personal and professional relationships; therefore, comprehension monitoring is a functionally relevant discourse skill for adults with TBI.

The specific implications of the results of this study can be related to assessment and treatment of clients with TBI. First, clinicians should be aware that clients with TBI may possess basic comprehension monitoring skills but may not employ them reliably during communication interactions. Therefore, evaluation of spontaneous use of comprehension monitoring skills should be part of a speech/language assessment with TBI population. While there are no standardized tools currently available to evaluate comprehension monitoring, the experimental paradigm used in this study could easily be adapted for use during informal discussions with clients to screen comprehension monitoring skills.

Second, intervention programs may focus on modifying the client's behavior or the client's environment. For client-oriented intervention programs, there could be a focus on

facilitating active processing of messages to increase the frequency with which comprehension monitoring is used. Additionally, intervention programs could be designed to increase the specificity with which clients with TBI signal comprehension difficulties. While training use of type 4 responses may not be functionally significant, decreasing the use of inadequate responses (e.g., "I don't know") or type 1 responses (e.g., "huh") and increasing the use of more specific response types (e.g., "What does VAT mean?") may facilitate more effective and efficient signalling of communication breakdowns.

Because executive functions are integral to the learning process, impairment in these higher level functions may prevent some individuals from relearning comprehension monitoring skills; therefore, compensatory strategies or environmental adaptations may be the most appropriate intervention goal. For example, other people in the client's environment could assume more responsibility for ensuring that the client understands incoming messages in order to decrease the risk of misunderstandings and communication breakdowns.

Limitations

The results of this study must be considered in light of a number of limitations. First, threats to the internal validity of the study will be considered. To make the task socially valid and naturalistic, the investigator sacrificed some experimental control. Specifically, although the investigator standardized the procedures as much as possible, the amount of feedback or encouragement provided to participants was necessarily dependent on participants' responses. Therefore, the behavior of the investigator could conceivably have influenced participants' responses.

Additionally, the investigator's on-line decisions regarding when to respond to participants' signals of comprehension breakdown may not have been consistent. Generally, the investigator repaired questions as soon as the participant signalled any

comprehension difficulties in an attempt to maintain a naturalistic interaction. However, given additional time, some participants might have produced more explicit types of responses. This may have altered the measure of form of CM responses used to signal comprehension difficulties.

Participants' responses may also have been influenced by a number of performance factors. Although most of the participants appeared to be willing to discuss the topic of "speech pathology," the investigator's impression was that a few of the participants in the TBI group seemed less interested in talking about the topic. Therefore, the number of overt CM responses provided by these participants may have been decreased by behavioral rather than cognitive-linguistic factors. Further, participants in the TBI group may have provided more nonverbal signals of problem detection. Because these were scored as CM responses only in the absence of any verbal responses, the number of signals counted as CM responses may have been reduced.

Second, threats to the external validity of the study must be considered. Because the TBI population is heterogeneous, replication of this study with a larger number of participants is required to investigate how widely the findings for this particular sample can be generalized to the TBI population. Further, the descriptive analyses completed for this study need to be verified using inferential statistical analysis with a larger number of data points.

The ecological validity of the experimental paradigm must also be considered; that is, the extent to which the experimental task and setting approximate everyday situations. A major goal of this study was to design an experimental paradigm which simulated everyday dyadic interactions. Participants appeared to engage with the investigator in the discussion and were generally willing to provide opinions in response to the discussion questions. However, the interaction was still artificial in that discussing an unfamiliar topic with a stranger may not be an everyday activity for most people. Further, the nature of the

interaction approximated a specialized form of discourse, an interview, rather than an informal conversation. The investigator initiated discourse, controlled topic selection, maintenance and termination, and regulated the pace of the interaction. The question/answer format may have influenced the frequency with which the participants signalled comprehension difficulties. Therefore the data collected in this study cannot necessarily be taken as a measure of typical comprehension monitoring ability but must be considered to reflect comprehension monitoring abilities in interactive settings similar to this experimental paradigm.

Implications for Future Research

The methodological considerations presented in the preceding section point out some directions for future research. First, a paradigm that allows more accurate measures of the covert process of detection of message inadequacies would increase our understanding of comprehension monitoring in both neurologically normal and impaired populations. For example, although response time did not prove to be a discriminating dependent measure for the present study, it could be used as a dependent measure for a more controlled experimental task to obtain information about the frequency and ease with which message adequacies are detected. Alternatively, a phenomenological approach could be employed wherein subject self-reports regarding awareness of question adequacy could contribute to our understanding of how message inadequacies are detected. Additionally, qualitative analysis of listener responses classified as non-CM responses could provide information regarding whether or not message inadequacies were detected. Undoubtedly, our knowledge of the process of comprehension monitoring could be enhanced by employing a number of converging measures of comprehension monitoring ability.

Second, because of the small number of data points, certain aspects of comprehension monitoring were described qualitatively and were not analyzed using

inferential statistics. Replication of this study using more participants and more exemplars of the various types of experimental questions would be valuable. This would permit further investigation of the relationship between experimental question type and CM response type. Also, response time measures could be compared across the different types of experimental questions to investigate the ease with which different types of message inadequacies are detected. Further, by including a larger number of participants with TBI, it may be possible to identify subgroups who demonstrate greater difficulty with comprehension monitoring than the general TBI population. If subgroups do exist, it would be important to determine whether these differences in comprehension monitoring are primarily quantitative in nature or if differences are also qualitative. It would also be of value to identify other factors that might account for greater variability of performance exhibited by the TBI group in the present study.

Third, given that executive control functions are commonly impaired by TBI, paradigms which can be used to identify these deficits should be developed. Such paradigms should permit dynamic assessment of impaired executive functions in order to obtain accurate estimations of their effect on functional ability.

Finally, treatment programs designed to facilitate active comprehension monitoring in children with language impairments have reportedly met with reasonable success (Dollaghan & Kaston, 1986; Ezell & Goldstein, 1991). There are, however, few reports of the efficacy of treatment programs designed to modify executive functions in adults with TBI. Rehabilitation of executive functions presents an interesting challenge: executive functions are integral to the learning process and they are therefore necessary for relearning executive functions such as comprehension monitoring. Research into whether impaired executive functions can be modified would have a direct impact on the goals and procedures employed in the rehabilitation of clients with TBI.

Summary

The results of this study provide empirical evidence that participants with TBI monitored their comprehension of spoken language less frequently than matched comparison participants. However, the results also suggest that the basic skills required for comprehension monitoring may be relatively intact in adults with TBI. As a group, the participants with TBI were capable of responding to a wide range of inadequate question types with a similar range of response types as the comparison group. The detection of comprehension breakdowns and appropriate reaction to these breakdowns is essential to successful communication. Because deficits in other cognitive-linguistic functions (e.g., selective attention or speed of processing) may interfere with their comprehension of incoming messages, comprehension monitoring is an important "survival skill" for adults with TBI. By actively processing incoming messages and monitoring one's understanding, comprehension difficulties can be detected and repaired to prevent misunderstandings and communication breakdowns. This study must be replicated before findings are generalized to a larger sample of the TBI population. Further research into the area of comprehension monitoring in both neurologically normal and impaired populations is required.

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Appendix A • Topic Paragraph

Not many people know exactly what a speech pathologist does. Basically, a speech pathologist is concerned with helping people to communicate with others. There are several disorders that may affect a person's ability to communicate. Articulation disorders affect a person's ability to produce certain speech sounds. Language disorders make it difficult to express or understand ideas using words and sentences. Voice disorders may result in a voice that is hoarse, harsh or breathy. Stuttering interrupts speech with hesitations and repetitions of sounds, words or phrases. A speech pathologist can help with these and other problems which affect communication.

Appendix B • Discussion Questions

1. How did you first hear about speech pathology?
2. What do you think a speech pathologist does?
3. What would you say when a client asked by a clinician in charge of assessments finished?
4. Do you think that yelling could damage a person's vocal folds?
5. If a child is making good progress in therapy, why should treatment be continued?
6. How long do you think it takes to become a speech pathologist?
7. If speech pathologists work with people of all ages, why can they only work with children?
8. Would you say that there are more speech pathologists?
9. When do you think a hearing impairment might be serious?
10. What age groups do you think a speech pathologist might work with?
11. When would you say a speech pathologist is responsible?
12. Do you think parents should be involved in planning their child's therapy?
13. Why would a speech pathologist suggest that children with speech disorders practice their speech at home?
14. Would you say that a speech pathologist is able to cure all communication disorders?
15. If a young child is missing both front teeth, why would that affect the way she pronounces words?
16. If a child had a serious stutter, why would others tease him?
17. How long do you think a speech pathologist typically needs?

18. If speech pathologists work in many different settings, why can they only work in schools?
19. How do you think an assessment could help a speech pathologist plan treatment programs?
20. Do you think FFVN should be a regular part of assessment?
21. Would some age groups have more speech problems than others?
22. How do you think damage to the RLN would affect speech?
23. Who would you say that a clinician asked by a doctor in charge of referrals left?
24. What kinds of things do you think might cause communication disorders in children?
25. Why would a speech pathologist really try that a treatment program of a client would complete?
26. What would be the significance of completing an extensive OPE during a speech assessment?
27. Who might refer a child with a speech disorder to a speech pathologist?
28. What would be the impact of a communication disorder on a child's ability to make friends?
29. What parts of the body would you say are involved in speaking?
30. Do you think that some stutterers are more than others?
31. When do you think speech pathologists should write assessment reports?
32. Why do you think communication disorders are considered to be serious?
33. If a child was unable to speak, in what other ways might she communicate with others?
34. If communication disorders are common, why are they rare?

- 35. How do you think VAT could be used to treat a child with a speech disorder?
- 36. How long do you think it would typically take to assess a child with a speech disorder?
- 37. When do you think a speech pathologist should participate?
- 38. Do you think that a speech pathologist should always repeat?
- 39. How do you think speech disorders could affect performance at school?
- 40. Do you think some disorders would be more difficult to treat than others?

Appendix C • Validation Study

Validation Study Instructions

I've developed a number of questions, some of which I think are easy to answer and others which I think are difficult to answer. However, it's not enough for me to decide that the questions are easy or difficult to answer. I need to confirm or disconfirm my judgments of how answerable the questions are.

You are asked to judge a series of questions which will be presented orally. You are to evaluate the "answerability" of each question. That is, how easy or how difficult it would be for you to answer the question. There are a total of 70 questions to be rated on the scale. Please indicate your rating of each question by circling the number which best represents your response to each question.

The questions are presented in random order so evaluate each question independently of the preceding question.

It is very important that you try to answer the questions as you rate the questions. Try not to just guess which are the experimental or control questions as this will **not** tell me how answerable both the questions are!!

Validation Study Rating Scale

1					2					3					4				
I can easily answer this question					I can attempt to answer this question					I can attempt to answer this question but I would be guessing					I cannot answer this question without further information				
1.	1	2	3	4						2.	1	2	3	4					
3.	1	2	3	4						4.	1	2	3	4					
5.	1	2	3	4						6.	1	2	3	4					

[etc.]

Appendix D • Experimental Question Types

Syntactic/Pragmatic: Inadequacies in form.

Ungrammatical Questions

For example:

Who would you say that a clinician asked by a doctor in charge of referrals left?

Why would a speech pathologist really try that a treatment program of a client would complete?

Elliptical Questions

For example:

Do you think that some stutterers are more than others?

When would you say a speech pathologist is responsible?

Lexical/Semantic: Inadequacies in content.

Contradictory Questions

For example:

If communication disorders are common, why are they rare?

If speech pathologists work with people of all ages, why can they only work with children?

Questions with Acronyms

For example:

How do you think damage to the RLN would affect speech?

What would be the significance of completing an extensive OPE during a speech assessment?

Appendix E • Informed Consent Forms

Informed Consent Form for Comparison Subjects

You are invited to participate in an investigation of how people interact in a conversation. You will participate in an informal discussion with me. The topic for the discussion will be "speech pathology." I will ask you some opinion questions about this topic. The time required for the entire session is about 30 minutes.

This session will be videotaped and audiotaped so that I can review the session later to score the results. Video and audio recordings will only be used for scientific purposes. This may include presentation of project results. All information about you will be kept confidential because your audiotapes and videotapes will be labelled with a number code known only to me. Therefore, I am the only person who will have access to research materials that would identify you. All such recorded materials will be kept in a secure place until the research is complete and then they will be erased.

Your participation in this study is completely voluntary. You may withdraw from the study at any time without any consequences. If you have any questions about this project, please call me at home at 431 - 0979. I will be happy to answer any questions you might have about the project. Thank you for considering this request.

Heather Hancock, BSc
Speech-Language Pathologist

I have read the above description and understand my role in the research project to be conducted by Heather Hancock. I agree to participate and to be videotaped. I have received a copy of this consent form.

Participant

Date

Heather Hancock
Investigator

Date

Information Letter for TBI Adults with no Guardian

You are invited to participate in an investigation of how people interact in a conversation. There are two parts to this study. First, I will obtain some information about your language skills by completing a brief evaluation. This will take about 30 minutes. Second, you will participate in an informal discussion with me. A topic for the discussion will be provided, and I will then ask you some questions about this topic. The time required for the entire session is about 45 minutes.

The discussion will be videotaped and audiotaped so that I can review the session later to score the results. Video and audio recordings will only be used for scientific purposes. This may include presentation of project results. All information about you will be kept confidential because your audiotapes and videotapes will be labelled with a number code known only to me. Therefore, I am the only person who will have access to research materials that would identify you. All such recorded materials will be kept in a secure place until the research is complete and then they will be erased.

Your participation in this study is completely voluntary. You may withdraw from the study at any time without any consequences. If you have any questions about this project, please call me at home at 431 - 0979. I will be happy to answer any questions you might have about the project. Thank you for considering this request.

Heather Hancock, BSc
Speech-Language Pathologist

I have read the above description and understand my role in the research project to be conducted by Heather Hancock. I agree to participate and to be videotaped. I have received a copy of this consent form.

Participant

Date

Heather Hancock
Investigator

Date

Information Letter for Legal Guardians

Dear Legal Guardian,

I am currently working on the Brain Injury Unit at Alberta Hospital Ponoka (AHP) as a speech therapist. I am studying the communication impairments which result from brain injury. I am preparing to conduct an investigation of how adults who have suffered brain injury interact in a conversation. Data collected during this study may identify ways to help adults with brain injury communicate more effectively. This project has been approved by the Research and Ethics Committee at AHP.

The language skills of potential participants will be evaluated. This will take about 30 minutes to complete. Participants whose language skills are within the range required for this study will be invited to participate in an informal discussion with me. The topic of the discussion will be "speech pathology and the role of the speech therapist." I will ask each participant questions about this topic to initiate a conversation. These questions will be opinion questions with no right or wrong answers. The discussion should take about 30 minutes. Neither the language testing nor the discussion will interfere with participants' regular AHP therapy schedules.

The discussion will be videotaped and audiotaped so that I can review the session later to score the results. Video and audio recordings will be used only for scientific purposes. This may include presentation or publication of project results. All information about participants will be kept confidential by labelling audiotapes and videotapes with a number code known only to me. I am the only person who will have access to research materials that would identify participants. All videotapes and audiotapes will be kept in a secure place until the research is complete, at which time they will be erased. Participation in this study is on a voluntary basis. Participants may withdraw from the study at any time without any consequences.

— has been identified as a potential participant for this study. If you are willing to let — participate, please complete the consent form and return it in the enclosed envelope to AHP. If you have questions about the project, please contact me at AHP (403) 783 – 7600 (Ext. 816) or at home at (403) 431 – 0979. I will be happy to answer any questions you might have about the project.

Thank you for considering this request. I look forward to receiving your response.

Heather Hancock, BSc.
Speech-Language Pathologist

Informed Consent Form for Legal Guardians

I/we, _____ guardian(s) of —, have read and understood the information letter regarding this study of how adults interact in a conversation. I/we understand that —'s language abilities will be tested and if his language skills are within the range required for this study, — will be invited to participate in a discussion with the investigator, Heather Hancock. In addition, I/we understand that this discussion will be audiotaped and videotaped.

I/we understand that the identities of participants in this study will remain confidential and will not be revealed in any presentation or publication of the results. All audiotapes and videotapes will be stored in a locked cabinet throughout the study. Following completion of the study, these tapes will be erased. I/we understand that participation is voluntary and that — may choose to withdraw from this study at any time without any consequences.

I/we have been informed that I/we may ask questions of the investigator, Heather Hancock, at Alberta Hospital Ponoka at (403) 783 – 7600 or at home at (403) 431 – 0979.

I/we agree to let — participate in this research project. I have received a copy of the letter providing information about the research project.

Guardian's Signature

Date

Guardian's Printed Name

Appendix F • Instructions to Participants

1. I am going to read aloud a short paragraph about speech pathology.
2. This paragraph will simply introduce the topic of speech pathology. You will not be asked to recall specific information from the paragraph.
3. I will then ask you some questions about speech pathology and the role of the speech pathologist.
4. Just respond to these questions as you would in any normal conversation.
5. You should respond to these questions based on your own opinions, knowledge and experiences. Please feel free to express your opinions and ideas as honestly as you can. I am interested in **your** ideas about speech pathology. There are no right or wrong answers to these questions.
6. Please feel free to ask questions at any time during the discussion.
7. Do you have any questions now?

Appendix G • Debriefing Letter

11 March 1993

Dear Participant,

Thanks so much for helping me with my project! Now that everyone has had a chance to take part in my study, I want to tell you a bit more about it. As you recall, we had an informal conversation about "speech pathology." I told you that I was interested in how people interact during conversations. In particular, I am interested in how people respond to difficult questions during a conversation and whether there are differences in how people with head injuries and people without head injuries respond to difficult questions.

Some of the questions I asked you were difficult to answer because parts of the question were missing or some words in the question were unfamiliar. Participants reacted to the difficult questions in different ways. Some people asked for more information while others tried to figure out what the question meant without asking for more information.

As all the data are coded and grouped together, I cannot give any specific information about how any one individual performed; however, the general finding was that the people with head injury asked for clarification of difficult questions less often than people without head injury. Participants in both groups did, however, signal comprehension difficulties in similar ways.

Thanks again for your help. I couldn't have completed my project without you! If you have any further questions or require any additional information about the study, please contact me at 431 - 0979.

Yours truly,

Heather Hancock, BSc.
Speech-Language Pathologist